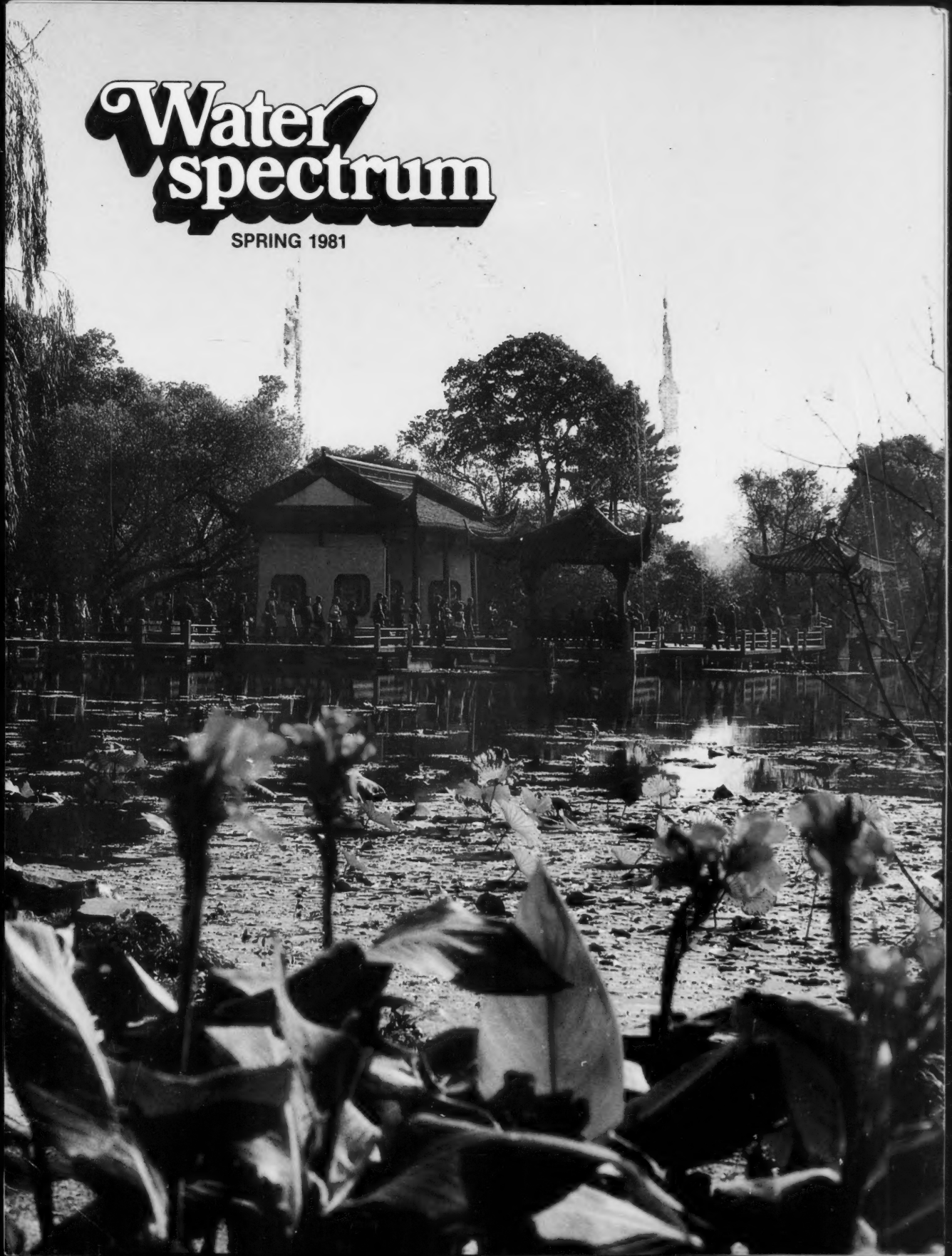
Water spectrum

SPRING 1981



Water spectrum

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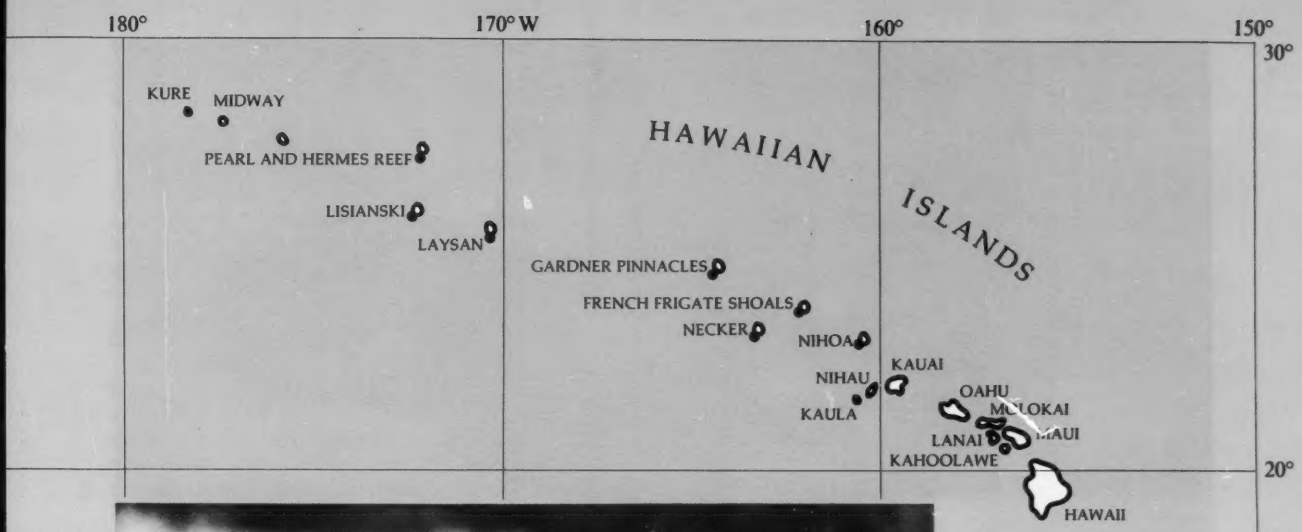
COVER: "Are not the pleasures of the virtuous and the wise similar to those of the lovers of landscapes?"
—Tsung Ping (AD 375-443)
(Photo by Bob Norton)



An adult female Hawaiian monk seal on the beach at French Frigate Shoals in the Hawaiian Islands. (Photos by the author.)

The Hawaiian Monk Seal:
An Endangered Marine Mammal

by Karl W. Kenyon

The Hawaiin monk seal *(Monachus schauinslandi)* is the oldest living seal in the world. The species has existed unchanged for 15 million years, and the fossil records show it exactly as we see it today. It is truly a "living fossil."

Mr. Kenyon retired in 1973 as a wildlife biologist with the U.S. Fish and Wildlife Service. He now lives in Seattle, WA, where he serves as a consultant in the field of marine wildlife.

The seals live only on nine tiny bits of land, the Leeward or Northwestern Hawaiian Islands. These remote specks of land stretch in a line northwestward for 1000 miles from the main Hawaiian Islands. By Executive Order No. 1019, signed by Theodore Roosevelt on 3 February 1909, these islands became the Hawaiian Islands Reservation. The reservation was establshed primarily to protect the indigenous bird populations from poachers and feather hunters. Today all but two of the islands (Midway and Kure Atolls) are included in the Hawaiian Islands National Wildlife Refuge of the U.S. Fish and Wildlife Service.

Two endangered species share the same stretch of beach. At left is a Green Sea Turtle.

The fossil record indicates that monk seals originated in the North Atlantic Ocean. There, today, a remnant population of the Mediterranean monk seal *(Monachus monachus)* leads an existence growing more precarious because of human encroachment on its habitat. The only other related species, the Caribbean monk seal *(Monachus tropicalis)*, probably became extinct sometime in the mid-1950s. It was last authentically reported in 1952. It was from this Caribbean stock that an ancient ancestor of the Hawaiian species crossed, probably through an ancient sea that covered central America some millions of years ago, to the Pacific, then traveled along the North Equatorial Current to Hawaii.

Unlike other species of seals which have survived near human settlements, monk seals appear to be incapable of adjusting to human presence within their habitat. The Leeward Hawaiian Islands remained uninhabited until the mid-20th century. Because of their isolation on remote oceanic islands the seals were shielded from contacts with land predators. Probably for this reason they never developed the ability to evade capture and they exist today as genetically tame animals. Early sealers found them easy prey; the seals simply lay on beaches where they were easily clubbed—nearly to extinction.

In 1824 the sealing brig *Aiona* was thought to have taken the last Hawaiian monk seal. In 1859, however, the bark *Gambia* reported taking 1500 pelts. The species must have been seriously depleted, for in 1911 two biologists failed to find any seals on Laysan Island during a six-week visit there.

Sailors shipwrecked during the 19th century in the isolated Leewards survived in large part because the genetically tame seals were so easily available to them as a food source. Adult monk seals may weight as much as 380 pounds.

Perhaps the early Polynesians, who settled more than 2500 years ago on the main Hawaiian Islands, found colonies of monk seals there. The seals, being easy victims, were undoubtedly quickly extirpated. No monk seals are known to have bred in the Main Islands in historic times, although a stray animal is occasionally taken on fishing gear among the Main Islands.

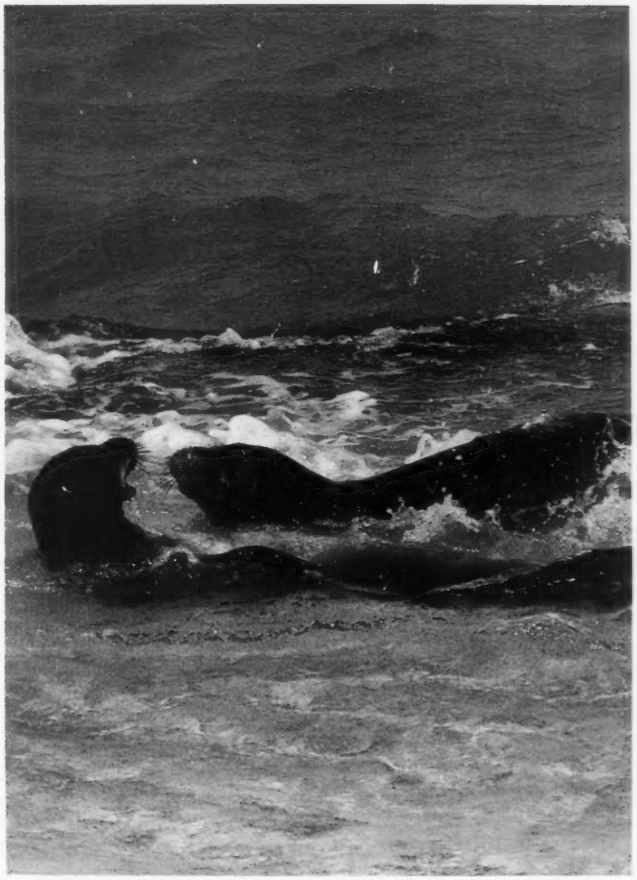
Three areas in the Leeward Hawaiian Islands are occupied by human settlements today. These are Midway and Kure Atoll and Tern Island at French Frigate Shoals. From 1956 to 1958 biologist Dale W. Rice and the author made the first studies of monk seals at Midway. (The United States Naval Station there occupied Sand Island, the main island at Midway.) We found no seals on Sand Island at that time, perhaps because a human population of about 2000 naval personnel and their pet dogs inhabited the island beginning in World War II. However, a small breeding colony of about 70 seals occupied nearby Eastern Island. Within the atoll areas, people and their dogs frequented only the beaches of Sand Island. Eastern Island was off-limits

because secret electronic gear was installed there, therefore disturbance of seals was at a minimum. Because of our wildlife studies we were allowed to visit the beaches of Eastern Island.

We found that mother monk seals, disturbed by human presence, interrupted the nursing of their pups to bellow and charge human intruders. Also, we determined that nearly 40 percent of the monk seal pups, even in this semi-protected area, died prior to weaning. Their failure to survive, we surmise, was caused by disrupted nursing periods.

When I visited Midway again in 1968 I found that the monk seals had completely disappeared from the entire atoll. I learned also that Eastern Island had become a recreational area after satellites took over the ground-based electronic communications on Eastern Island.

It appears probable that the Midway monk seal population disappeared during the 1960s because of human disturbance. Another nearby atoll, Kure, remained uninhabited until 1960. When Rice and I observed this area during our 1956–58 studies we found that the population there numbered 120 or more seals and we recorded births of 22 pups. In 1960–61 the U.S. Coast Guard installed a Loran Station on tiny Green Island at Kure and stationed 20 men there. A study by William Wirtz of the Pacific Project revealed that at least 19 percent and possibly as much as 27 percent of the pups born there did not survive.



A monk seal courtship ritual in the surf. The female seal is on the left.

Prior to occupation by the Coast Guard, the beaches on Green Island formed the main pupping grounds for the Kure seal production. During the 1960s and 70s, because of frequent distrubance by men, dogs, and vehicles on these beaches, the seals largely abandoned them and gave birth to their pups on small offshore sand islets within the lagoon. Apparently mortality there was high. The sand spits are often washed over by mid-Pacific storms, and in addition, they are near deep water frequented by large tiger sharks. the population suffered a serious decline.

When biologist Ancel M. Johnson of the U.S. Fish and Wildlife Service conducted a study there in 1977, the highest of many counts yielded 52 seals and recorded only 10 pups born. Further studies in 1979 and 1980 indicated that survival of young seals at Kure is negligible. In 1980 I found only two subadults and three juvenile seals during a two-week observation period at Kure. The remainder of the population, where my highest count was 35 seals, consisted of old animals.

In recent years the U.S. Coast Guard has made every effort to reduce disturbance of seals on beaches. The northern section of Green Island was placed off-limits to all personnel and everyone is careful not to disturb the seals. Although it is encouraging that more pups are now being born on the beaches of Green Island, the survival of young is still not sufficient to maintain the population.

At French Frigate Shoals, where Tern Island is occupied by a Coast Guard Loran Station, the situation is far different. Because of rough water within the surrounding coral reef and the presence of eight other islets, the seals are able to isolate themselves from human disturbance and the population has prospered. In the late 1950s, only 43 seals were counted at French Frigate Shoals. I surmise that the population was in an early stage of recovery from the 19th century sealing activities. During the 1960s and 70s the population greatly increased, and a count of 196 seals was obtained in 1978. On inhabited Tern Island, however, no pup has been born during the period of human occupation.

The largest island in the Leewards is Laysan. Today it remains uninhabited except during visits by biologists. Two of these, Brian and Patricia Johnson, have conducted studies on Laysan from 1977 to 1980. They have been careful to avoid any disturbance of the seals and observed that among 103 pups born, only 9 died prior to weaning. This low rate of mortality is very different from the mortality observed at Midway and Kure. Human disturbance is not, however, the only cause of monk seal mortality.

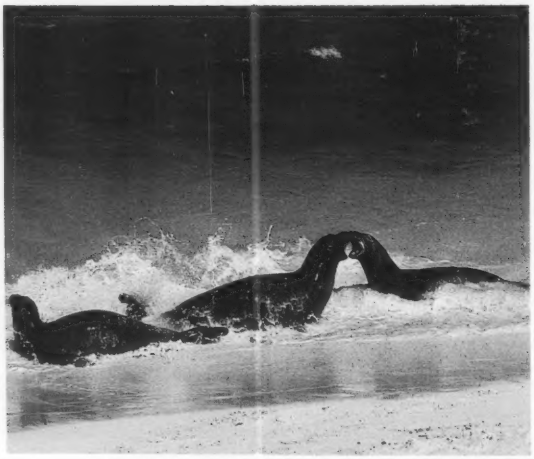
In a 1969 survey of the Leewards, I observed 235 seals on basking beaches. Among these, 29 (12 percent) bore wounds that I believe were inflicted by sharks. Another biologist, Robert L. DeLong, found that on Lisianski Island 13 percent of the seals and on Peal and Hermes Reef 35 percent bore shark-inflicted scars. We also found seals so badly bitten that although they survived the shark attack and were able to come ashore, they soon died there. The number of seals that succumb to shark attack at sea is of course unknown.

In 1977 the United States Marine Mammal Commission contracted with Dr. L. R. Taylor and G. Naftel to study sharks at French Frigate Shoals. They caught 23 tiger sharks and found that the stomachs of three contained monk seal remains. Although no witness has ever recorded a shark killing a seal, it is apparent that shark predation is an important mortality factor.

Increased fishing activities during the past two decades in the North Pacific Ocean and Bering sea may affect seal populations. Not only is a tremendous biomass—millions of tons of fish—removed annually from the environment, possibly affecting food resources available to seals, but fishing gear may cause direct mortality. In recent years, considerable numbers of northern fur seals were found entangled in scraps of fish net. Nets and lines that remain around a seal's neck or body cause characteristic scars, far different from shark bites, when they wear through the skin. I have seen monk seals on Leeward Hawaiian Island beaches bearing scars similar to those inflicted by fish nets on fur seals.

In addition, I have watched monk seals purposely entangling themselves (for unknown reasons) in scraps of nets and lines on their basking beaches. In these observed instances the seals were eventually able to free themselves. How many die at sea when entangled in fishing gear or lost scraps of nets is another unknown.

In 1977 and 78 on Laysan Island, the Johnsons observed that disease may be another serious cause of mortality. During their study period they observed 22 "sick" seals which came ashore and died. The seals exhibited varying degrees of disability. During periods ranging from several days to weeks, the seals appeared comotose or paralyzed where they lay on beaches prior to death. Under the direction of Bob DeLong, a team of pathologists investigated the diseased seals. Liver samples from two of them revealed the presence of ciguatoxin. This is the agent which produces fish poisoning or ciguatera in man and other mammals. Ciguatoxin is formed by a microscopic protozoan dynoflagellate. When this organism is consumed by other marine life the toxin is concentrated through the food chain and renders



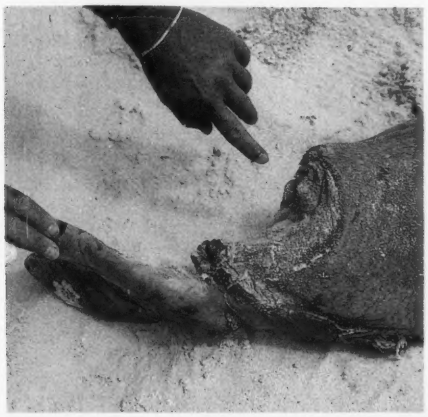
Another example of the monk seal courtship ritual.

This adult Hawaiian monk seal shows signs of passage through oil-polluted waters.

the flesh of certain fishes poisonous. Because outbreaks of fish poisoning often follow destruction of coral reefs, it is suggested that ciguatera occurs in the Leeward Hawaiian Islands because of extensive harbor dredging activities during recent past years at Midway Atoll. Further studies are in progress by pathologist William G. Gilmartin to determine the degree to which monk seals may be afected by ciguatoxin and to discover a possible antidote for it.

In the 1956–58 period of our Midway studies, the tasty fish from surrounding waters were frequently relished by naval personnel stationed there and no fish poisoning problems occurred. In recent years, however, several cases of fish poisoning have occurred there and the consumption of fish caught at Midway is now prohibited. Since no "sick" seals were ever reported at Midway, it is only a matter of conjecture as to whether or not ciguatera had any part in the disappearance of the Midway seal population.

At Pearl and Hermes Reef, less than 100 miles southeast of Midway, the seal population suffered a precipitous decline between 1958 and 1978. The highest survey count in the late 1950s was 338 seals, but on a survey there in 1978 we could find only 26 seals. Because this atoll is uninhabited, I doubt that the disappearance of the seals was caused by direct human disturbance. We may speculate, in view of the "sickness" observed among seals at Laysan, that perhaps ciguatera caused this population decline. However, since no observations are available from this isolated area, the cause of this drastic population reduction remains a mystery. Some have suggested that the seals migrated to French Frigate Shoals, where the population showed an increase during the same period. Observations at French Frigate Shoals conclusively show, however, that the population increase there was the result of local reproduction and not immigration.



This seal suffered a fatal shark bite. It managed to get to the beach, but died there.

Because of the various causes of mortality noted above, the total Hawaiian monk seal population has declined during the past 20 years by almost 50 percent. In the late 1950s surveys indicated that the population numbered about 1300 seals (the highest 1957–58 count was 1206 seals). Surveys in the late 1970s indicate that the population might be as low as 700 seals (in 1977 the count was 625 seals). The question today is, will the Hawaiian monk seal ultimately survive?

In the hope that the species may be preserved in spite of encroaching human activities within its habitat, the designation of "critical habitat," as required under the Endangered Species Act of 1973, is in the process of being defined. Although this designation was originally drafted in 1976, in cooperation with the U.S. Marine Mammal Commission, the National Marine Fisheries Service has not,as of presstime, officially defined the monk seals' critical habitat.

Hawaiian monk seals are frequent victims of discarded fishing net lines. Note the cord constricting the seal's torso.

In 1980, the National Marine Fisheries Service, which has a lead responsibility for the welfare of the Hawaiian monk seal, failed to appropriate funds to continue needed studies of the species.

Alarmed at the prospect that appropriate action was not being taken to preserve this endangered species, Connecticut Senator Lowell P. Weicker obtained a supplementary appropriation of $100,000 to be administered through the Marine Mammal Commission for needed monk seal studies. In May and June 1980, a team of biologists under the

A pair of Man-o-War birds cruises above a Hawaiian monk seal in the surf of Laysan Island.

A Hawaiian monk seal pup nurses on the beach after birth. A pup at birth will average 35-40 pounds, will reach a weight of 140 pounds just after weaning, and will suffer a weight loss to 100 pounds after it begins to fend for itself. Adults may attain a weight of 500 pounds and a length of slightly more than seven feet.

direction of Bob DeLong spent five weeks on Lisianski Island studying monk seals.

The biologists were able to attach instruments to adult male seals (no females were disturbed) which recorded the number and depth of dives that they made within their feeding habitat. The instruments were all retrieved and revealed records of nearly 5,000 dives. A most important discovery was that on many dives the seals descended to depths of more than 100 meters.

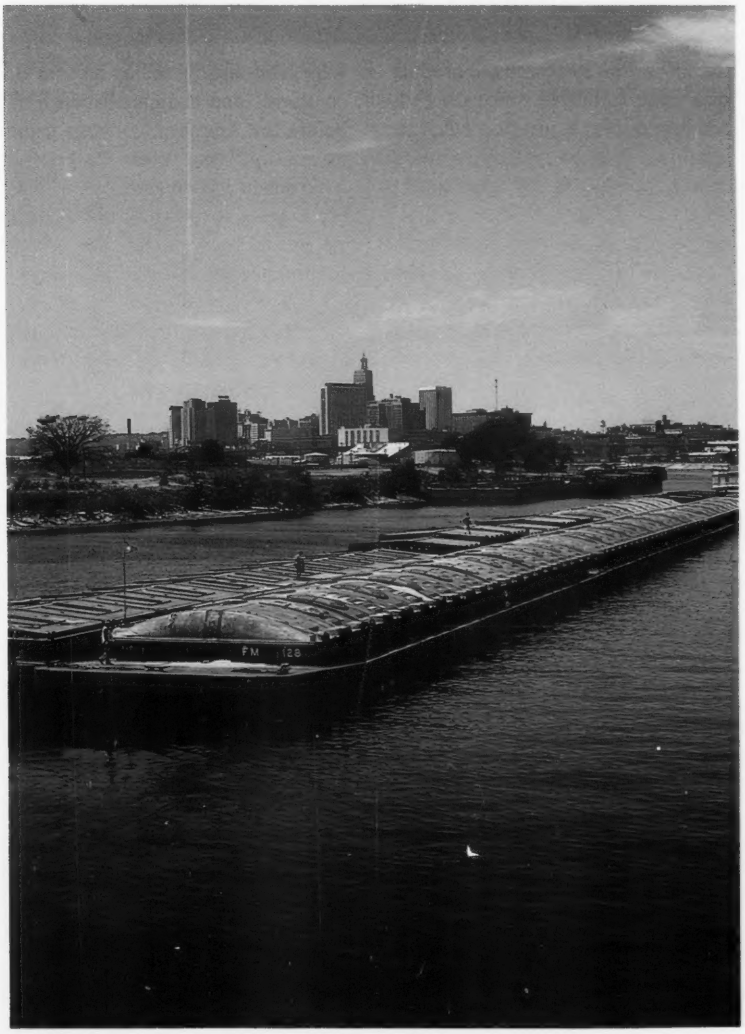
In addition, a recovery team (as provided for under the Endangered Species Act of 1973) was formed in March of 1980 and held its first meeting in mid-April. The 12 members of this committee were recruited from both responsible governmental agencies—the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. Also included were biologists from the State of Hawaii and non-governmental organizations. It will be their responsibility to review all available information on the monk seal and to assure as nearly as possible that human disturbance of the seals and their habitat be kept to a minimum. Toward that end, every precaution will be taken to keep populations, such as the one at French Frigate Shoals, healthy and prosperous, and to take all possible measures to aid the recovery of populations that have dwindled, such as the one at Midway and Kure.

Surely a creature that survived for 15 million years without man must not be allowed to perish from the earth after only a brief period of human contact. ■

Hawaiian monk seals regulate their body temperature by wallowing in the sand, as shown here, and by basking in the edge of the surf.

Editor's Note: This is the second in a series on endangered marine mammals. See "The West Indian Manatee" in the Winter 1979–80 Water Spectrum *(Vol. 12, No. 1).*

The U.S. Waterway System: A Joint Venture



Eight loads of grain and towboat departing south from St. Paul, MN.

by Guy J. Kelnhofer, Jr.

The inland waterways of the United States constitute an integral part of our national system of transportation. There are more than 25,000 miles of commercially navigable river, lake and coastal channels, and they move about one-sixth of the nation's domestic intercity freight.

Since 1824, the Federal government has assumed responsibility for keeping these waterways navigable, and has directed the U.S. Army Corps of Engineers to clear designated rivers, dredge shoals and sandbars, and build and operate navigation locks. It is calculated that the Federal government has spent a total of about $10 billion on navigation improvements, including the Great Lakes and the coastal ports, since 1824.

Of this total, about $7 billion is generally attributed to the expenditures made on the shallow-draft portion of the system. In fiscal 1978, new construction on shallow-draft channels totaled $347 million while operation and maintenance cost $240

Dr. Kelnhofer is Director of Research for the National Waterways Conference, Inc., and a river basin planner with 30 years of experience in planning local, regional, national and international water resources projects.

million. However, it is recognized that these figures on navigation expenditures are not very reliable because they include funds which benefit non-navigation uses. Nevertheless, there is considerable concern about the amount of Federal money being expended on shallow-draft inland navigation services.

The provision of these Federal investments in the construction and maintenance of in-channel improvements has been of vital importance to the development of a modern waterway transportation system. What is not so readily apparent is that, by themselves, these improvements did not create a viable system of transportation on the inland waterways. More often than initiating commercial transportation, these improvements only made it a more feasible, safer and more reliable prospect.

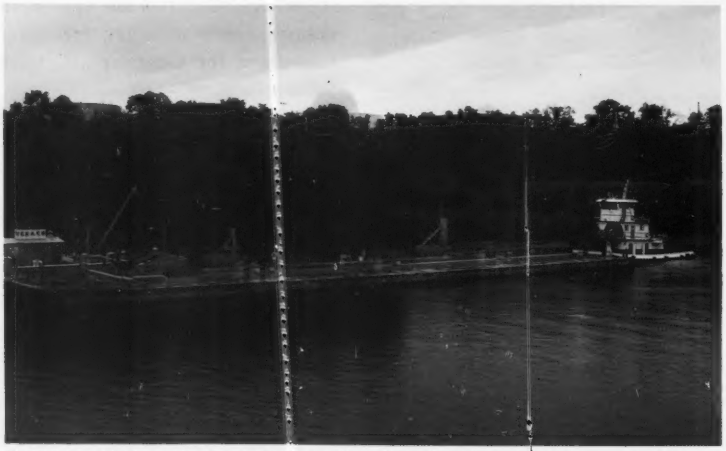
Public perception and, in turn, public policy, are strongly influenced by the repeated assertions of critics who portray the water transportation system as the product of unaided Federal investments. Using that kind of formulation, they find it easy to excoriate the commercial users of the inland waterways as "free loaders" who enjoy publicly supplied navigation facilities without payment (in the past) of any cost. The fact is that the navigation system is the product of a joint venture in which the Federal government is just one, albeit an important one, of the parties which contribute the funds that make waterway navigation possible. It is the purpose of this article to offer a more realistic presentation of the nature of the inland waterway transportation system as it has developed in the United States.

Loading coal at the NSP dock in Minneapolis, MN. (Photos courtesy of Twin City Barge and Towing Co., St. Paul, MN.)

It should be evident to anyone that the Federal government did not create the rivers which make up most of the inland navigation system. Nature provided the rivers. They were here and in use as arteries of commerce and communication long before the American colonists came to this continent. What the Federal government has done is to make improvements to parts of those river systems to better enable them to accommodate the vessels using them.

Even before 1824, when the Federal government first appropriated money for inland navigation work, the rivers of North America carried a substantial amount of waterborne traffic. If the national government had never spent a dime on the improvement of the waterways for navigation, they would still be carrying traffic. The purpose of making the national investments was not to institute navigation where it had never existed but to make the natural waterways into safer and more efficient channels of commerce. To that end, the national government has not only invested national funds, it has also encouraged other interested parties to join with it to build and operate the facilities and services needed to create a national system of inland navigation services.

A number of parties had an interest in the use of the rivers and lakes for navigation. The settlers needed them to obtain supplies in a time when roads were few and often



Placing a petroleum tanker at Erickson Petroleum for discharge in Newport, MN.

impassable. Growing communities needed river transportation to provide better trading connections with distant markets. Farmers needed river transportation as a way to get their produce to market. Land promoters and other businessmen needed water transportation to attract settlers and enhance business investments. The government needed water transportation to knit together a growing country with a vastly dispersed population. None of these parties could singularly do all that was necessary to create a water transportation system—one which was well equipped, reliable, safe and efficient. When problems arose, solutions came from among the interested parties.

Over time, an understanding developed among the different parties who shared a common interest in the promotion of a water transportation service. Local community groups and private businessmen built and maintained docks, warehouses and other facilities as they were needed on the shores of the rivers. They took care of moving freight to and from the docks, storing it and loading and unloading the barges.

Private businessmen also made the investments that were needed to provide vessels for the transport of goods between ports along the waterway. It fell to the national agencies to keep the channels passable and to do the in-channel work of controlling and regulating channel flows. From this division of labor there developed a symbiotic relationship between the Federal and the nonfederal users of the inland navigation system.

What was peculiar about this cost-sharing arrangement was that it was never formalized into a precise set of rules and mutual contract provisions. Instead, it grew up gradually over many years, with each participant in the building process doing his job and contributing his special services to develop a fully reliable water transportation service. An objective examination of the development process shows that it has all the characteristics of a joint-venture project.

Loading coal at Pillsbury Terminal in St. Paul, MN.

When two or more parties cooperate together in developing, operating and maintaining a set of interdependent activities for their mutual benefit, one would characterize that as a joint venture. Being an interdependent operation, no one of the parties to the venture can succeed in it except through the cooperative actions of the other participants. If there is no written agreement, spelling out both the separate and collective responsibilities of the cooperating parties, there must be at least common rules of procedure, standards of practice and an established method for dividing the work among the several parties.

Participation in a joint venture is not forced. Each of the parties joins in the common effort only in expectation of receiving benefits which are at least equal in value to the costs of that party's participation. If the investments of the participants are large, involving the construction of projects having a long life, there is an implicit assumption that each of the parties will continue to meet its respective obligations in the joint venture for an extended period of time.

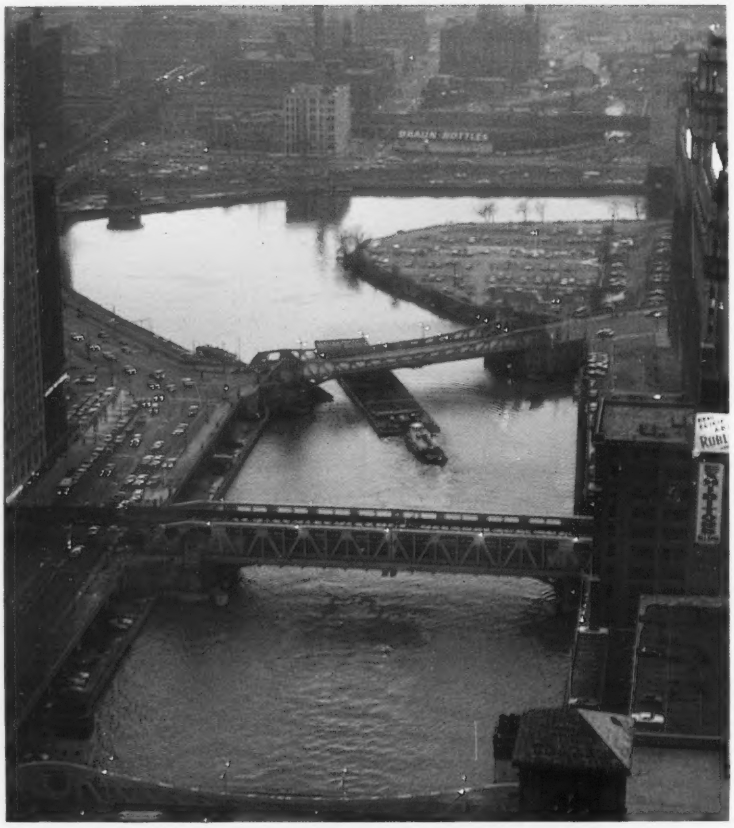
If this arrangement endures for many decades and if its basic terms

are not challenged by any of the principals, the parties in the venture acquire a moral if not legal equity in the continuation of that arrangement. Should any of the parties decide later that the original terms of the participation are no longer satisfactory, they are obliged by considerations of that acquired equity to negotiate with the others for changes in the terms.

The transportation service provided on the inland waterways is the product of such a joint venture. The participants are the Federal government, the state and local governments, and the private sector. Each of the parties has a separate but well defined interest in the creation of an effective waterway transportation service. And each of the parties has an established role to play, in cooperation with the other participants, to achieve that common objective.

The Federal government has provided the in-channel improvements which are necessary to establish and maintain a controlled and usable depth of water. It has also supplied navigation aids to guide vessels along waterways. The Army Corps of Engineers keeps the channels open through periodic dredging, and operates the locks through which barges and ships pass.

As their share in the cost of this venture, the state and local governments have accepted the obligation for constructing, operating and maintaining port facilities. Included in port management are responsibilities for docks, terminals, elevators, sewer and water lines, lighting, communications, police and fire protection, and street and highway connections. The states and local governments have also agreed to contribute lands, easements, or rights-of-way required for construction and subsequent maintenance of the in-channel improvements; provide suitable areas for the disposal of dredged materials; provide and maintain essential depths in berthing areas and in the local access channels serving the public terminals; accomplish all the necessary alterations in the water, sewer, drainage and other utility facilities; pay a determined portion of the costs of alteration of railroad and highway bridges and approaches made necessary by the in-channel improvements; pay a portion of the costs of the in-channel improvements where a special local benefit has been obtained from the improvements, and hold the national government free of any damages due to the construction of the in-channel improvements.



Towboat and barge negotiating curves and bends in the Chicago River.

Private industry has made its financial contribution to waterways transportation service by purchasing specially designed barges and towboats for hauling freight, by building warehouses and tanks for storing freight, installing equipment for the mechanical loading and unloading of vessels, supplying rail sidings for moving goods in and out of the terminals, and by making available the trained manpower to operate and maintain the equipment.

It is evident, therefore, that improving the navigability of the existing waterways is only one of the many steps required in a systematic program of investments whose end objective is the creation of a water-based transportation service. It is possible to build an effective system of water transportation only by having these different investments made in a coordinated sequence. While the

"hidden hand" of the market place may have dictated the ratio and timing of many of the private investments in waterway development, the Federal government took care to guide and direct the state and local governments to support the work of the national water development agencies with corresponding local works. In fact, legislation by Congress required local government agencies to enter into written agreements with these Federal agencies, committing themselves to certain contributions as a condition for the national investments in channel improvements. Section 221 of the Rivers and Harbors Act of 1970 (P.L. 91-611) stated:

> "After the date of the enactment of this Act, the construction of any water resource project by the Secretary of the Army, acting through the Chief of Engineers, or by a non-Federal interest, where such interest will be reimbursed for such construction under the provisions of Section 215 of the Flood Control Act of 1968 or under any other provisions of law, shall not be commenced until each non-Federal interest has entered into a written agreement with the Secretary of the Army to furnish its required cooperation for the project."

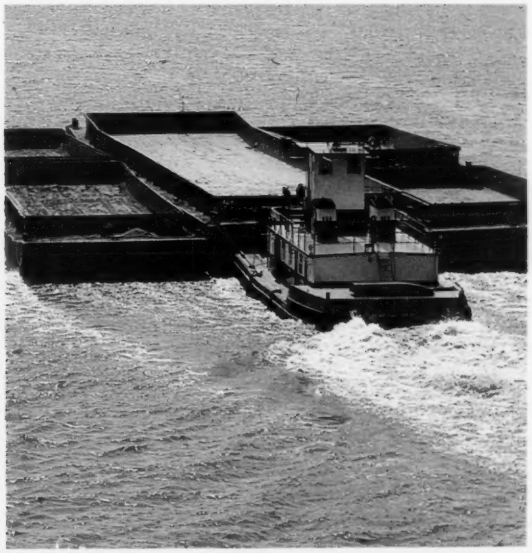
Therefore, while no single master contract exists on paper which binds the several public and private parties together as joint-venture partners for the whole system, it is evident that the inland waterways transportation system is a joint creation and the joint responsibility of those several parties.

The completed joint-venture project can be seen as a system of interrelated facilities and services coordinated and balanced to supply efficient and reliable transport services. The integrity and the indivisibility of these related investments may be difficult to grasp because they have been made over an extended time frame and in an incremental fashion. One can better appreciate the interrelationship of the parts to the whole by visualizing how a completed waterway transportation system would appear if it were built and presented for sale to a syndicate of users as a "turn key" project—one that is ready to deliver a full range of transportation services on the very first day of use.

It becomes apparent then that all the elements would have to be assembled and readied for operation at the same time: the ports and their supporting equipment and service, the barges and towboats with their mooring, fueling and unloading facilities, and the locks, dams, channel markers, and dredging equipment, and whatever else may be required.

The total budget for this project would represent the cost of producing an operational waterway mode of transportation where none had existed before. While no such accounting has been made, it is obvious that money has been budgeted over the years in an amount sufficient to construct, equip and operate the inland navigation system of the United States. Collectively, public and private entities have put in place the

Loading grain at Continental Grain Elevator, Savage, MN.



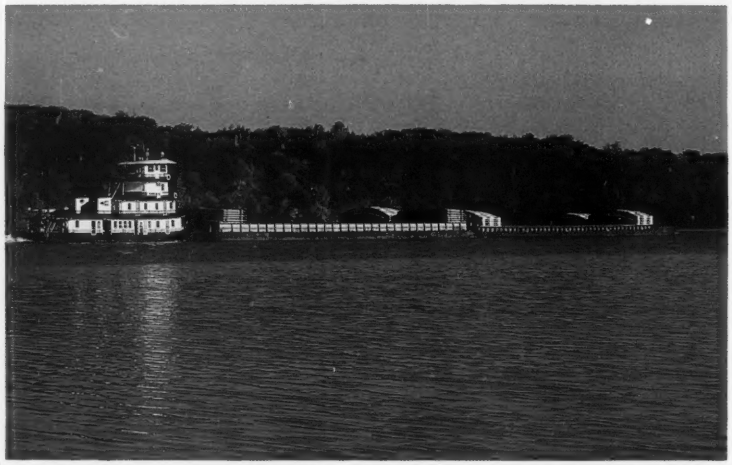
Towboat with five empties, sand and gravel barges.

full range of equipment, facilities and services which are essential to move vast quantities of goods safely and expeditiously over our inland waterway system. It is a characteristic of the inland waterway system in the United States that no single entity, syndicate, or government has paid that bill by itself. Consequently, there is no single group or governmental level which can now claim to own or control this mode of transportation in our country.

Of course, it is true that the Federal government pays nearly all the costs of the navigation improvements which it installs, operates and maintains. It is also true, however, that the related water transportation improvements installed by the state and local goverments and by the private sector are built, operated and maintained with little or no help from the Federal government. While the Federal contribution is well documented and widely known, there is no public account of the investment made by the other partners in supplying this mode of transportation.

No one knows how much money has been invested by the nonfederal sector in the facilities and services of the inland waterways transportation system. Nevertheless, there are some illustrative examples.

Farmer's Union GTA Elevator in St. Paul, MN, with an oil tow passing in front.



Towboat with four loads of coal.

The most comprehensive survey of the inland ports was made in the Mid-America Ports Study, which was published by the U.S. Maritime Administration in 1979. It found that, in a 17-state region on the inland waterways, over 7,000 acres of land were devoted to general cargo and dry-bulk commodity storage. At an average of $25,000 per acre, that storage is worth $155 million. Another 355 million bushels of elevator storage of grains, at $5 per bushel, has a value of about $1.8 billion. There is tank storage in place for 340 million barrels of liquid bulks. At only $15 per barrel, this storage capacity has a value of more than $5 billion. The survey did not reveal how many miles of railroad trackage have been built to service the portside tanks, warehouses and grain elevators. It is estimated that this trackage on level ground has a value of about $250,000 per mile, not including the cost of switches. There were 2,300 separate pieces of equipment at these inland mid-America ports for loading and unloading liquids, dry bulk commodities and general cargoes—everything from forklifts, bulldozers, straddle trucks, tractors, conveyors, and cranes. A single 100-ton crane, with its auxiliary equipment, costs about $500,000.

The present barge fleet consists of more than 24,000 dry-cargo barges, almost 4,000 tank barges and 4,380 towboats and tugs with a combined horsepower of 6.4 million. It is estimated that this fleet has a 1980 replacement value of almost $13 billion. With over 80,000 employees on the barge fleet, the annual payroll is around $1 billion.

In that same study, traffic growth on the inland waterways between the year 1976 and 2000 was forecast.

Traffic is expected to increase at an annual rate of 2.9 percent, going from 440 million short-tons annually to 900 million short-tons. A very large nonfederal investment will be required in new terminal facilities to service that increased traffic. It is estimated that about $9.7 billion in nonfederal funds will have to be invested by the year 2000 to acquire about 100 miles of waterfront and about 11,000 acres of land to provide sites for about 1,000 new terminals. These investments are needed to service such commodities as petroleum products, $4.4 billion; coal, $2.2 billion; cash grains, $1.4 billion; fertilizer, $900 million, and chemicals, $770 million,

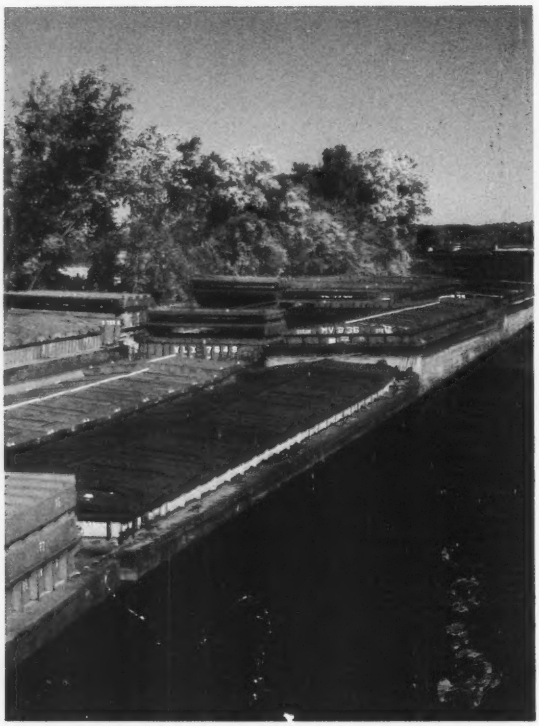
These capital investments by the nonfederal sector do not include the annual overhead expenses of manning and maintaining these improvements; nor the fees, licenses and taxes paid to local, state and Federal agencies; nor the insurance payments. Neither is there any indication of the amounts spent for installing the utilities, communications, and security systems needed to operate these terminals. The report did not cover the entire inland waterway system; it excluded the Great Lakes, the intracoastal waterways, and the Columbia-Snake system in the Pacific Northwest.

With all of their limitations, however, these figures do help to illustrate the comparability between the size of the Federal investments for construction and annual maintenance and the size of the nonfederal investments in providing transportation services on the inland waterways. It is evident from these illustrations that there is ample reason to believe that the nonfederal investment greatly exceeds the expenditures made by the Federal government in funding this essential transportation service.

One reason why it is so difficult to compare the contributions of the several partners in this joint venture is that each one programs and budgets his investments independently of the others. Some degree of public agency coordination is mandated by the Congress. It requires local governments to contract with the Corps of Engineers to ensure that the supporting nonfederal public improvements will be made as required. For all the other nonfederal navigation improvements, the amount and timing are left to the discretion of the individual contributors.

Should the private sector, for example, decide that it would not be profitable to operate through the

Congested fleeting site at St. Paul, MN. This is the staging area for barges waiting to be loaded.



Another fleeting site in St. Paul, MN, where barges are waiting to be discharged.

Twin City Shipyards' barge fabrication plant in St. Paul, MN.

locks and ports constructed on a particular waterway segment, they are under no obligation to provide the transport equipment and services for which those public facilities were constructed. The reverse is also true. The Federal government is under no obligation to improve a particular stretch of river just because it would be profitable for water carriers to provide service to communities along that waterway segment.

Although all the parties are engaged together in a common objective a water transportation service—they only coordinate navigation-related investments; they do not integrate them. As a result of this practice, no one knows how much it costs in total to construct an operational waterway transportation service for the United States. Since we do not know what proportion of the total cost is borne by each of the interested parties, it is not possible to determine whether the present division of costs among all the participants is a just and satisfactory one.

Much of the agitation for legislation which would require the commercial users to repay most, if not all, of Federal navigation expenditures rests on the belief that these users are not paying their fair share of the navigation costs. This widespread belief reflects a basic misunderstanding of the role of the Federal government in providing inland waterway transportation services to the public. There is little public understanding of the large share of the costs which are borne by those whose investments transform the transportation potential of an improved river channel into the actual reality of a fully functioning water-based transportation service.

It is not surprising that these misunderstandings occur when navigation-related investments made for a common purpose are placed in separate unrelated accounts. To correct these misapprehensions, it will be necessary to revise the accounting procedures. The traditional accounts support the fiction that the in-channel investments of the Federal government alone are responsible for the benefits obtained by the U.S. inland navigation system.

In the proposed accounting procedure, it would be appropriate to raise questions about the distribution of the costs among the several participants. There is no reason to assume, based on the available evidence, that the present division of the costs is not equitable. Nor is there evidence to suggest that a reassessment would reduce rather than increase the national share of the total cost of providing water transportation services on the nation's waterways. ■

Lake Restoration:

Cleaning the Raindrops

by Joanne C. Chance

"Now the storm is over, the sky is clear, the last rolling thunder-wave is spent on the peaks, and where are the raindrops now . . . ? In winged vapor rising some are already hastening back to the sky, some have gone into the plants, creeping through invisible doors into the round rooms of cells, some are locked in crystals of ice, some in rock crystals, some in porous moraines to keep their small springs flowing, some have gone journeying on in the rivers to join the larger raindrop of the ocean. From form to form, beauty to beauty, ever changing, never resting . . ." —John Muir, *My First Summer in the Sierra.*

Aquatic weeds, or macrophytes, invade a lake due to excessive nutrients and shallow water depths.

When viewed through the holistic, artistic eyes of John Muir, lakes are but one of the many forms of water, a raindrop for man's enjoyment. But in addition to sparkling sunshine, these mega-raindrops often reflect man's degradation of the surrounding watershed. An ambitious program is underway in Washington State and across the nation to turn back the clock, to save dying lakes by applying practical lake restoration and watershed management techniques. Under this program, funded jointly by the U.S. Environmental Protection Agency, the Washington State Department of Ecology, and a local sponsor such as the parks department of a city government, man's technological tools which played a part in the degradation of the lake are reapplied to restore it to a higher level of water quality.

"The most common complaint of lake users is that of excessive algal blooms . . ."

The first step in the restoration process involves an in-depth limnological analysis of the lake. The limnological study is designed to seek out the causes of the water quality problem, whether it be bacterial, sediment, or nutrient related. The most common complaint of lake users is that of excessive algal blooms, which are green, slimy, and often odorous clouds of photosynthesizing microscopic plants in the water column. In shallower shoreline areas, larger rooted aquatic plants called macrophytes can grab and pull at swimmers' legs and arms and seriously endanger their safety. Macrophytes may also affect water quality by recycling nutrients from the sediments into the surrounding waters.

Lakes which receive an excessive nutrient load are called eutrophic. Examples of sources of the excessive nutrients are storm drains discharging into the lake, aerial application of fertilizers to forest lands, septic systems, agricultural operations, upstream lakes, industrial and sewage treatment plant sources, or even the underlying sediments of the lake itself. These nutrients are fertilizers which stimulate the growth of aquatic plants—be they microscopic algae or macroscopic cattails or lily pads. In other lakes, high bacterial levels due to such factors as storm drains, surrounding livestock populations, or even residential waterfowl populations, have resulted in closure of the lake to swimming. Finally, aesthetically unappealing "muddy water" has been the instigating factor behind several lake restoration efforts.

The successful approach to lake restoration involves a thorough evaluation of the entire lake ecosystem which is comprised of the lake itself and its surrounding watershed. To accomplish this, all surface water, ground

Prerestoration streambank erosion on Lake Fenwick's inlet stream (URS Company Photo)

Ms. Chance is a sanitary engineer with the lake restoration program of the Washington State Department of Ecology, Olympia, WA 98504.

water, precipitation, in-lake, and manmade (storm drains for example) pollutant inputs to the lake system must be quantified. Likewise, all outputs from the lake must be assessed. Nutrient and water budgets are developed for the lake in question. The percentage contributions of nutrient, sediment, or bacterial pollutant sources to the lake are calculated. After evaluating the cost and environmental feasibilities of several alternatives and complying with state and Federal requirements as to a favorable environmental impact statement and public review of the proposed project, a final plan for restoration of the lake is produced.

"The successful approach to lake restoration involves a thorough evaluation of the entire lake ecosystem..."

CASE STUDY: LAKE FENWICK

A case in point is Lake Fenwick, a lake located in King County, Washington. A public park, a necessity for state and Federal funding, is located on the lake shoreline. Lake users complained of turbid waters. A lake restoration study conducted by the City of Kent and its consultant (the URS Company) revealed that extensive new residential development in the upper watershed had occurred. Since the amount of impervious materials (roads, rooftops, etc.) increased in the upper watershed, the natural ability of the watershed to absorb rainfall and runoff and hence curtail erosion was greatly reduced. As a result, the quantity and velocity of stormwater flows in the small stream feeding Lake Fenwick increased tremendously. Although a mere trickle during fair weather, the stream flow during storm events increased an estimated 150 times over base or dry weather flows and carried 300 times the amount of sediment. A vertical bank six feet high in places was cut by the stream flow during storm events. A pedestrian path through the wooded area was

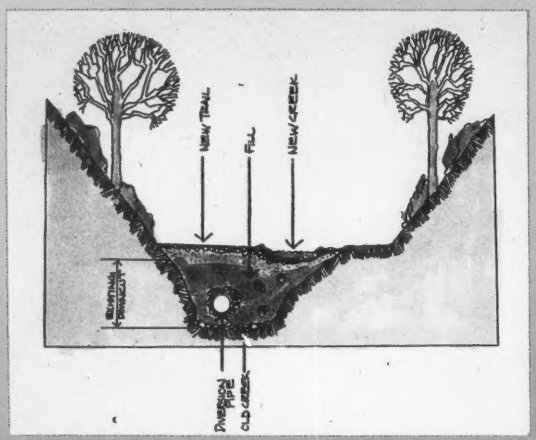
Storm drains discharging into Lake Fenwick, Washington, during fair weather (left) and during a storm event (right). (Photos courtesy of URS Company.)

Aerial view of Lake Fenwick illustrating the impact of a storm on water clarity. (URS)

Installation of a stormwater diversion pipe at Lake Fenwick. (URS)

perched precariously on the edge of the new ravine.

After a complete restoration analysis was conducted and approved, a stormwater diversion and treatment system was constructed. The majority of the stormwater is now diverted in the upper watershed into a buried storm drain. The steep-sided stream banks were repaired and a new streambed was constructed. A small amount of water was allowed to follow the natural stream corridor during fair and foul weather. A pedestrian path was reconstructed along the restored stream. The stormwater is carried in the nearby, buried storm drainage pipe to a pre-existing marshy pond which will now act as a sediment basin where soil particles are allowed to settle out of the water. The overflow from the sediment pond discharges clear water to the lake. In addition, a surface water and drainage code was adopted by the local government to control sediment at its source.



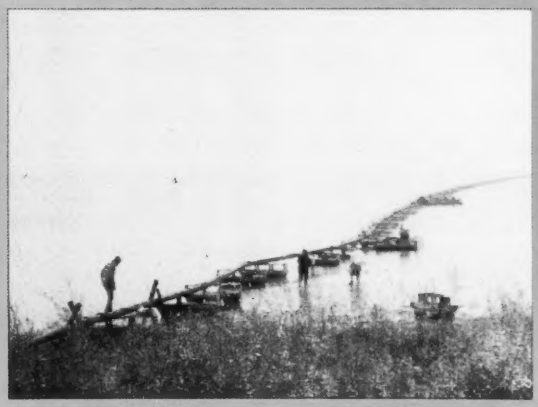
Artist's rendering of the appearance of inlet stream after lake restoration. The storm drain is buried under a reconstructed streambed and path. (Illustration courtesy of URS.)

"A relatively small dilution rate will significantly reduce algal biomass production . . ."

RIVERS AS RESTORATION AGENTS

The mighty Columbia River will play a major role in the restoration of Vancouver Lake, a shallow, highly polluted 2600-acre lake in the Columbia River lowlands of southwestern Washington. In the late 1800s the freshwater lake was a home for sturgeon and reached a depth of 20 feet. Today the average depth is only 2 to 3 feet.

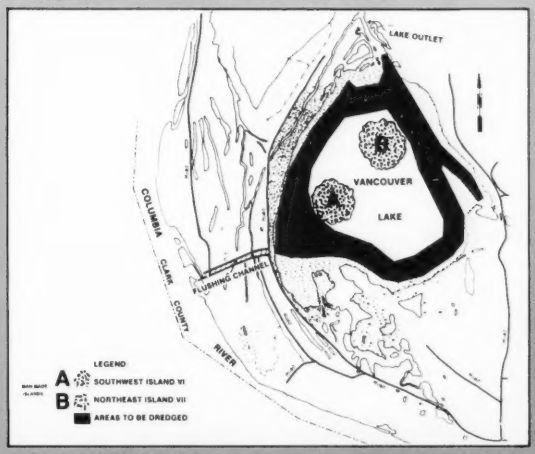
Natural and manmade perturbations have resulted in a coliform bacteria, turbidity, and nutrient problem. Since 1965, the Port of Vancouver has been leading the effort to restore the lake to a higher level of water quality which



The pilot dredge study of Vancouver Lake, Washington.

will be enjoyed by recreators from the nearby Vancouver-Portland metropolitan area.

Extensive study resulted in a soon-to-be implemented plan to selectively dredge channels averaging approximately 1000-feet in width along the shoreline of essentially the entire lake. The channel will be approximately 5- to 13-feet deep, and an estimated nine million cubic yards of material will be removed from the lake bottom. An open channel will be constructed to carry 300 cubic feet per second (cfs) of dilution water from the Columbia River into Vancouver Lake. The dredged channels will then circulate or "flush" the dilution water through the lake which ultimately discharges back into the Columbia River. The two-culvert system with flap and sluice gate will be controlled in order to protect migrating and resident fish populations. The designed dilution flow of 300 cfs represents a dilution rate of 5 percent.



The restoration plan for Vancouver Lake includes a flushing channel which will carry dilution water from the Columbia River and dredged channels along the lake's periphery.

Recent limnological research has indicated that a relatively small dilution rate will significantly reduce algal biomass production. It is hypothesized that the "new" dilution water flushes out self-stimulating growth substances secreted into the water by the algae, in addition to lowering nutrient concentrations. Lake pollutants were also attacked at their source when local government officials adopted more stringent ordinances and plans.

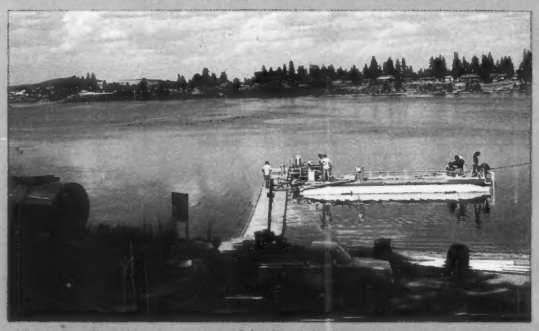
"SNOWFLAKES" IN THE WATER

Another popular lake restoration technique is that of chemical precipitation of phosphorus. Excess phosphorus is the most prevalent culprit associated with algal blooms. A flocculent, such as salts of aluminum or

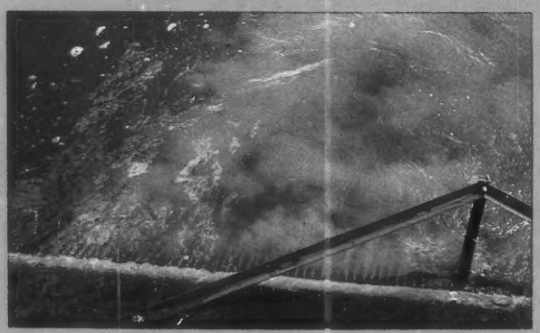
Algal growth before alum treatment on Medical Lake, Washington.

iron, are mixed into the upper foot or two of lake water, and the highly charged hydrolyzed metal ions produced by these salts in solution reduce the repulsive forces between charged particles which are in a colloidal suspension in the water. With these repulsive forces suppressed,

gentle mixing of the water (as produced by a boat's propellers or the wind) results in particle contact. The forces of attraction cause particles to adhere to each other, producing progressively larger agglomerations—which have the appearance of "snowflakes" in the water. As the "snowflakes" or floc becomes so heavy that it settles to the lake bottom, phosphorus is chemically trapped in the floc. In addition, phosphorus in the lake bottom sediments is effectively sealed off or locked into the bottom muds where it cannot recirculate into the water and cause nuisance algal or macrophyte growth. The treatment is reported to be effective for approximately 3 to 5 years.



Alum application barge on Medical Lake.



Alum applied to lake water on Medical Lake.

OTHER APPROACHES

There are numerous other commonly accepted lake restoration techniques—such as lake drawdown to consolidate bottom sediments and kill macrophytes, withdrawal of nutrient-rich waters from the lower levels of the lake (hypolimnetic withdrawal), and numerous methods of attacking pollutants before they reach the delicately balanced lake ecosystem.

"Man must be innovative and bold to maintain and improve environmental quality . . ."

For example, sewering of homes often improves the water quality of a lake. Control of nonpoint pollution (that not originating from a pipe) by installation of on-site measures to control sediment or nutrient movement caused by agricultural, forestry, construction, or mining activities are often solutions to lake degradation. Public education as to the proper use of lawn and garden fertilizers and proper septic tank maintenance is often an important factor in lake improvement.

In our rapidly changing technological society, man must be innovative and bold in the methods and approaches used to maintain and improve environmental quality. Lakes, the larger raindrops, so readily available to a majority of the population for our recreational enjoyment, are indeed a delicate system, a valuable resource to be protected. They are ever changing, too, and not always for the better. ■

"Constraints Threaten Barge Industry..."

Petroleum and coal represent fully 60 percent of the total barge traffic. The bulk commodities moved by barge are vital to this country's industries and utilities. (Photos courtesy of The American Waterways Operators, Inc.)

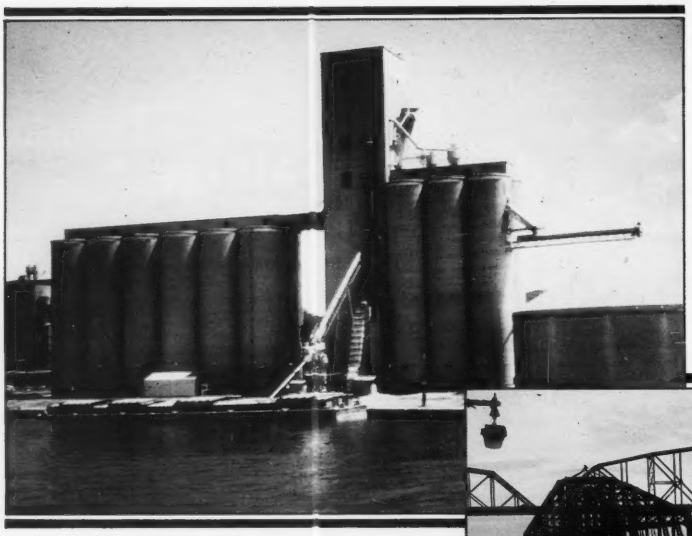
by Anthony L. Kucera

There are numerous dimensions to the nation's barge and towing industry. It has a colorful past and a dynamic future. It is a major employer comprised not only of large corporations, but also small, privately owned companies. To some people, it probably evokes images of sternwheelers and Mark Twain; to others, it is seen as the awesome workhorse of America's waterways.

Mr. Kucera is President of The American Waterways Operators, Inc., the national association representing the interests of the barge and towing industry.

Editor's Note:

This article is being published in keeping with Water Spectrum's *policy of providing an open forum on water resources topics. Mr. Kucera's article represents the views of an organization that has a vital interest in the future of America's inland waterways.*



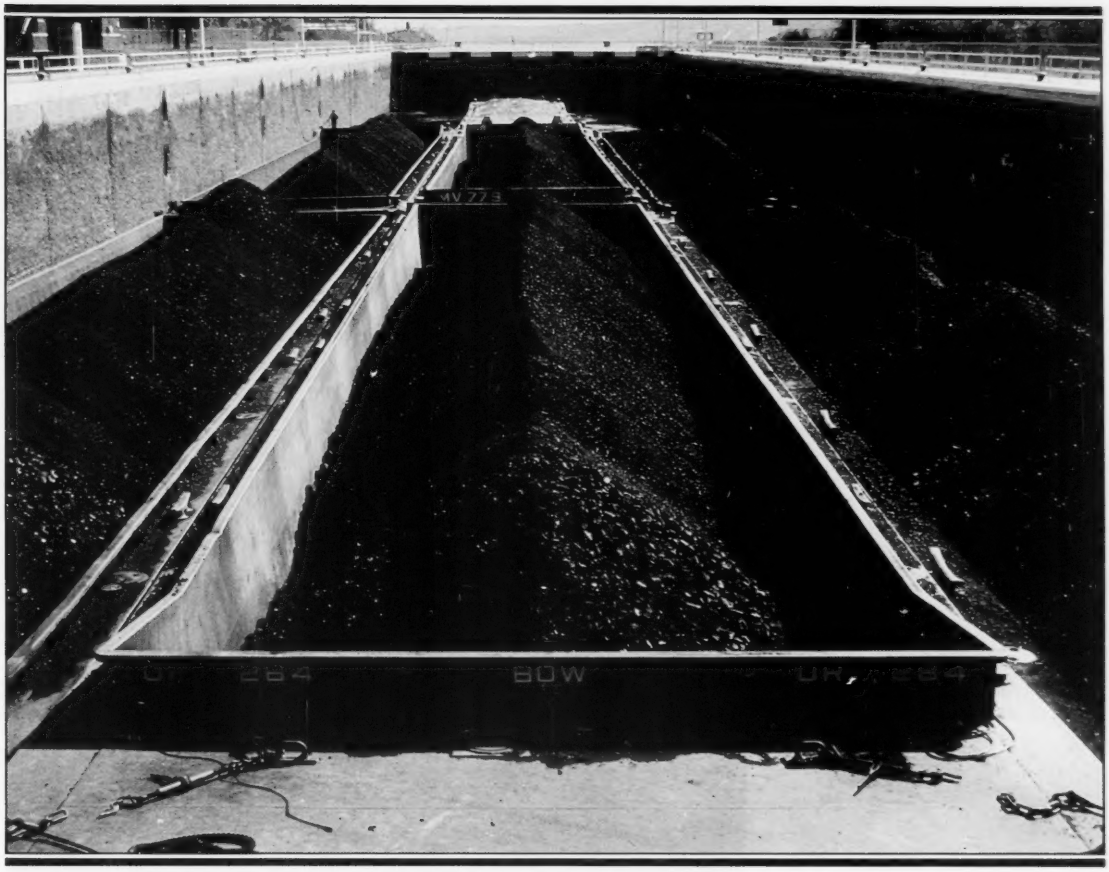
The barge industry moves almost 40 percent of U.S. grain exports to deep-draft ports for transshipment to oceangoing vessels. Grain elevators, such as this one on the Mississippi River, are prevalent along the waterways that serve the nation's agricultural heartland.

Locks and Dam 26, at Alton, Illinois, has long been one of the major bottlenecks on the Mississippi River. It sometimes takes barge tows up to three days to pass through this important facility, which is located just below the confluence of the Mississippi and Illinois Rivers.

Above all, the barge and towing industry has established a solid record of being responsive to the needs of America's shippers and consumers. It is fuel-efficient, cost-effective and highly productive. With these qualities, it is no wonder that this industry has assumed a major role in moving the nation's freight.

In 1978, the latest year for which figures are available, barges hauled some 662 million tons of essential bulk materials. Sixty percent of all barge traffic involves fuel: petroleum and petroleum products (42 percent) and coal (18 percent). Other leading barge cargoes include building materials: sand, gravel and cement (13 percent); grain and grain products (9 percent); chemicals (6 percent), and iron and steel products (3 percent). This commerce represents the lifeblood of America's economy, the fiber of its industrial and agricultural strength. In short, they are the goods that keep the nation strong and on the move.

While the inland waterways industry moves about 12 percent of the nation's total freight, it does so at only 2 percent of the total cost. For those shippers with access to barge transportation—and 87 percent of the nation's major cities are located on navigable waterways—it is the obvious choice for economical movement of bulk goods. According to figures by the Transportation Association of America, it costs only about one-half cent to move one ton of cargo



Forecasts point to a surge in the export of U.S. coal, a major commodity moved on the nation's inland waterways.

one mile by barge, compared to more than two cents by rail and more than 10 cents by truck. The cost advantage of barge transportation is due in large degree to its excellent fuel efficiency. Study after authoritative study has shown that this transportation mode moves bulk freight more cheaply than anything on wheels. This is not meant to denigrate rail and truck service—they have their advantages, too. But if you have a large volume of commerce to move, you simply can't find a lower cost mover than water transportation.

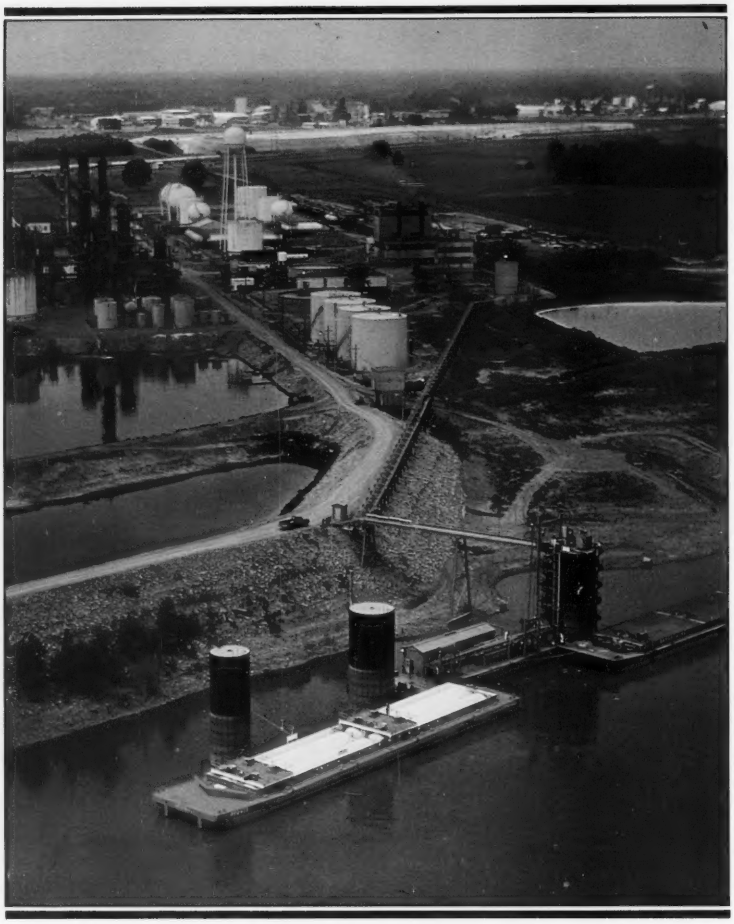
The advantage of barge transportation lies in its economy of scale. One barge carries the equivalency of 15 rail cars or 57 trucks.

Those are the key elements of the equation. Efficiency, combined with the capacity to haul massive quantities of bulk products, equals high productivity. The barge and towing industry is ready and able to do its job.

Regulatory Obstacles

There are, however, major constraints facing the industry and the ability of the waterway system to handle increased traffic. The problem is not the physical dimensions of the waterways; given adequate maintenance dredging, they are wide enough and deep enough to accommodate substantial growth for years ahead. In fact, we have both the physical and technological ability to maintain our waterways as a first-class system.

The problem, for the most part, is artificial and of our own making. The U.S. Army Corps of Engineers is being severely constrained, through a host of legislative and regulatory obstacles, from maintaining adequate channel depths and modernizing inadequate navigation facilities on the rivers. More and more incidents are occurring which demonstrate the seriousness of the present situation.



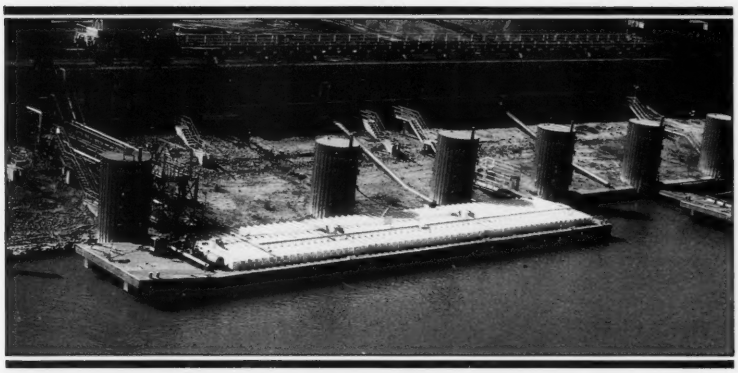
The low-cost transportation provided by the barge industry promotes industrial development on the 25,000 miles of navigable waterways in the U.S.

The gravity of the restrictions on dredging was exemplified this last July by a massive traffic backup on the upper Mississippi River near Bellevue, Iowa. At one point, 26 line-haul towboats, pushing approximately 330 barges, were immobilized until the channel could be reopened. Their cargo—including some 462,000 tons of grain, coal, crude oil and other commodities—was valued at over $50 million. This vital commerce was brought to a virtual standstill.

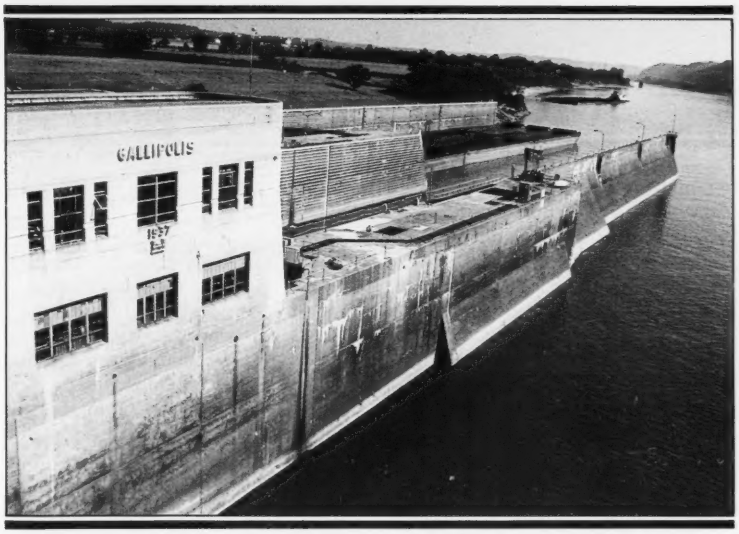
Similar incidents occurred last summer on other reaches of the Mississippi and on the Arkansas and Missouri Rivers. The blame cannot be placed solely on the Corps of Engineers or any other single agency. The problem is precisely that there are so many regulatory agencies involved. Today, the Corps must consult with regional offices of such Federal units as the Environmental Protection Agency, the Fish and Wildlife Service and the Soil Conservation Service, plus myriad agencies from individual states.

Taken together, these requirements serve to make the Corps' task a nearly impossible one. Since regulations affect every business, this may sound like an unjustified complaint. Not so. Even the General Accounting Office (GAO) addressed this problem in a report issued last June, *Managerial Changes Needed to Speed Up Processing Permits for Dredging Projects.* Citing the spread of Federal regulation in this area during the last decade, the report states:

Striking a balance among these competing objectives has complicated the process for issuing dredging permits, involving several Federal agencies and increasing the time required to process applications. Lengthy processing is costly to applicants, makes planning difficult, and can hinder construction and water transportation. During fiscal year 1979, the average time to process dredging permits at the Baltimore, New Orleans, and Philadelphia districts of the Corps of Engineers ranged from 4 to 10 months. Some were in the process more than 2 years. Corps regulations indicate that total processing time generally should not exceed 3½ months.



The barge industry leads in fuel efficiency, but all bulk transport modes are excellent energy savers. A viable national transportation policy would recognize the advantages of each mode and promote intermodalism.



Gallipolis Lock on the Ohio River, completed some 43 years ago, is identified as one of several transportation bottlenecks requiring urgent attention.

The Corps was successful in signing memoranda of understanding in 1980 with the other Federal agencies involved in the permit process, a step that should help shorten that process. The new plan calls for three classes of permits, and only those having a major environmental or policy impact can be "forced up" to Washington for a decision. All others should be decided at regional level, after consultation between Corps officials and their regional counterparts from other agencies.

The barge and towing industry believes that another necessary step is to change Section 404(T) of the Federal Water Pollution Control Act Amendments of 1972. This section provides for state involvement in controlling discharge of dredged material within the navigable waters of each state. It should be amended to define clearly the authority of the Corps of Engineers in maintaining commercial interstate water transportation.

Aging Locks

Another constraint to barge industry growth is created by the condition of many of the navigation locks on the inland waterways. Many of these facilities were built as public works projects and in response to postwar unemployment. When the Ohio River project was completed in the late 1920s, the Corps of Engineers was projecting 13 million tons of traffic annually on that river. The Ohio handled 23 million tons its first year of operation, 152 million tons in 1978, and is expected to exceed 200 million tons in 1980 when final statistics are completed. Many locks have gone for over 40 years without a major rehabilitation or modernization, and the Corps has done a commendable job keeping them in working condition.

The Gulf Intracoastal Waterway celebrated its 75th anniversary in 1980. It originally was expected to handle about 5 tons annually; it carried over 120 million tons of commerce last year. On the Mississippi River near St. Louis up to 60 tows routinely wait at Locks and Dam 26. It is not unusual for a

The tremendous capacity of barge tows, combined with their excellent fuel efficiency, makes this industry more cost effective than other surface transportation modes. A single hopper barge has the capacity of 15 100-ton rail cars.

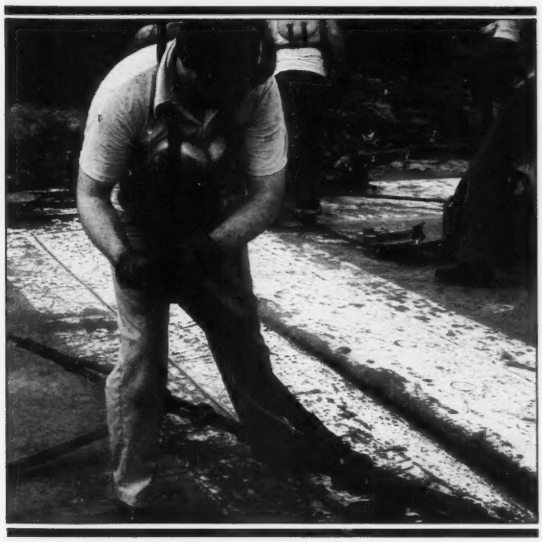
tow to take 2½ to 3 days to clear this most infamous of navigation bottlenecks, a task that should take less than an hour or two. The Corps has finally received approval to go ahead with a replacement lock there—following funding delays and numerous court battles with the railroads and environmental groups. It will be another 8 to 10 years before the new facility is completed. By that time millions of tons of traffic will have been diverted to more costly modes of transportation. There is a conspicuous need for a second chamber at this site; the demand is there.

We may, however, defeat ourselves with artificial constraints once again. Section 101 of Public Law 95-502, the law authorizing construction of the main replacement lock, calls for an evaluation of the need for such a second chamber. The Section 101 study is being prepared by the Upper Mississippi River Basin Commission, and was scheduled for completion by January 1, 1982. The Commission has sought an extension of the final report deadline. The inland waterways industry vigorously opposes this. We know that, in order for the second chamber to be economically efficient and properly engineered, funds must be appropriated for it not later than October 1983. The decision process cannot be delayed beyond the dates set by law or serious diseconomies will beset the project. These are delays and costs the economy can ill afford.

Several other facilities have the potential for becoming just a troublesome as Locks and Dam 26. The Corps of Engineers' National Waterways Study has identified the Vermilion Lock on the Gulf Intracoastal Waterway, Gallipolis and Emsworth Locks on the Ohio, Winfield Lock on the Kanawha, Marseilles Lock on the Illinois, Bonneville Lock on the Columbia, and several others. Plans should be made today for their efficient replacement or rehabilitation.

USER FEES

Any discussion of needed capital improvements to the inland waterways system inevitably turns to the question of who will pay. The freedom of the inland waterways from user charges extends back at least to the Northwest Ordinance which stated that the system "shall be common highways and forever free . . ." That policy, which recognized the navigable rivers as a national asset benefiting numerous interests, was restated many times during the country's first 200 years. But it was changed in 1978, when Congress passed Public Law 95-502, which provided for a Federal tax on fuel used in commercial transportation on inland waterways.



Waterborne transportation has the added advantage of an excellent safety record.

The fuel tax became effective last October. The tax receipts will be placed in a trust fund to partially offset construction and rehabilitation expenditures on the waterways. Another provision of Public Law 95-502, Section 205, calls for a study of the impact of waterway user taxes and charges. That study is being undertaken by the Departments of Commerce and Transportation, and is scheduled to be submitted to Congress by this September 30.

Now that the user tax has become law, the concerns of the barge industry about this tax are basically twofold. First, the industry believes that the cost of maintaining the waterways system, which is used for many purposes other than navigation, should not be solely the responsibility of the barge industry. Second, the level of the tax should not be pushed higher than that already established by law. To do so would irreparably harm the barge industry and the industries it serves.

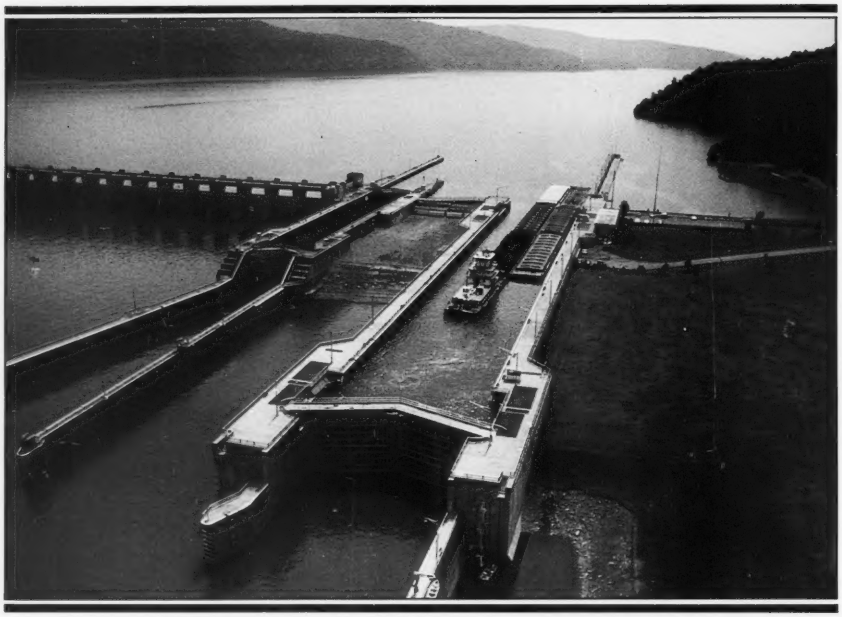
On the first point, we were pleased to see the Corps of Engineers recently release a preliminary study on the feasibility of allocating Corps expenditures on the waterways to various users. The American Waterways Operators, Inc., has consistently urged that such a study be undertaken.

The results of this preliminary effort include the following major findings:

- At least eight "user" categories were identified, including commercial navigation, power, recreation, flood control, water quality, water supply, fish and wildlife and environmental enhancement.
- It is possible to perform allocation studies with "as high a degree of accuracy as any cost allocation performed by the Corps for other purposes."
- Non-commercial navigation costs may average "as much as 25-30 percent of total 'navigation' expenditures."

We firmly believe that this study should serve as the springboard for a nationwide cost allocation effort. It is a welcomed first step—it must be followed by a comprehensive, nationwide accounting of these costs.

The barge industry faces more than enough challenges to its viability through the current level of fuel taxes and other constraints. For example, the Mid-America Ports Study concluded that "The waterway user charge and the constraints imposed by the . . . locks and dams which reach capacity over the forecast period will reduce waterborne traffic by as much as 16 percent by the year 2000." With the stresses that undoubtedly will be placed on our waterway transportation system in the next several years, it should be obvious that additional, unnecessary burdens are counter to the nation's best interests. While numerous factors—such as environmental, safety and economic concerns—must be considered in the Federal decision-making process, we believe that the pendulum has swung too far to the side of regulation.



This nation's extensive system of locks and dams—built and maintained by the U.S. Army Corps of Engineers—is working to the benefit of many groups. In addition to commercial navigation, the waterway system is used for recreational, flood control, water quality, water supply, fish and wildlife, and environmental enhancement purposes.

A more realistic and balanced approach to these important decisions is required. Such an approach requires recognition by the nation's policymakers that the barge industry plays a vital role in the total U.S. transportation system.

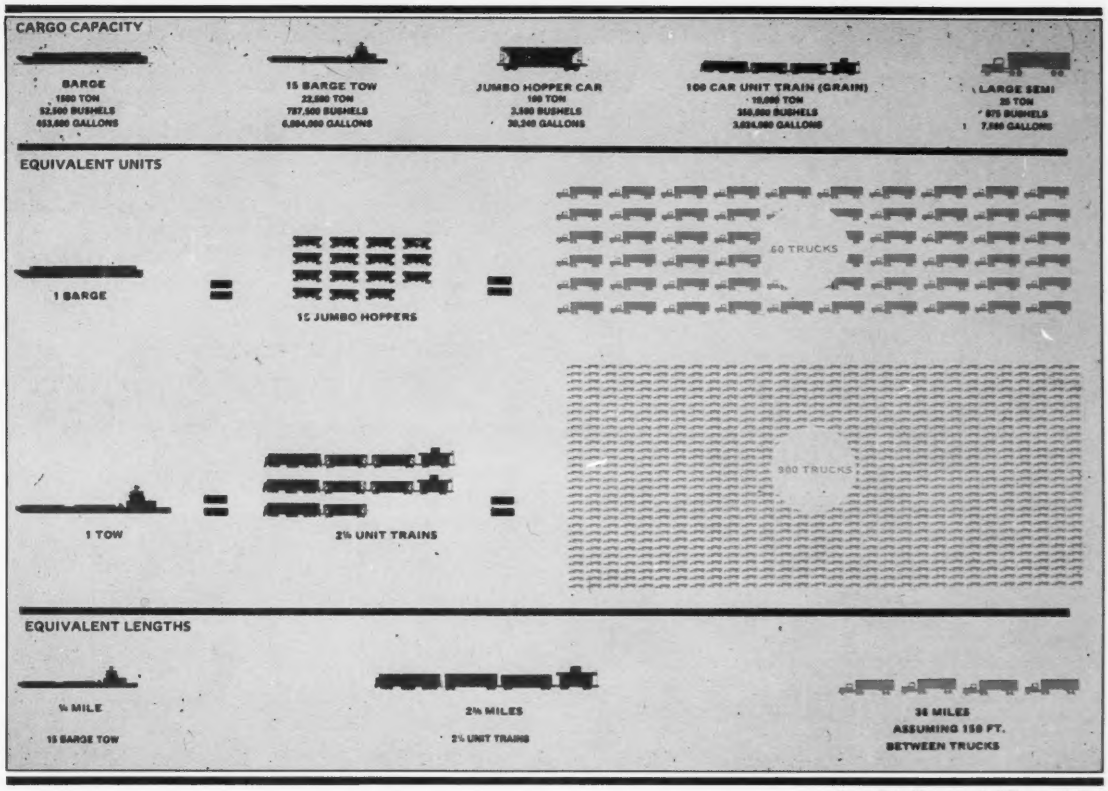
This country's 25,000 miles of navigable waterways are truly a national asset, beneficial to a wide variety of interests. We must use them to their fullest potential.

SURGE IN TONNAGE EXPECTED

All indicators point to a dramatic increase in demand for barge capacity in the next several years. The latest traffic projections contained in the preliminary findings of the Corps' National Waterways Study predict a tripling of waterborne coal traffic between 1977 and 2003. Agricultural productivity and exports are expected to continue expanding rapidly, as will growth in industrial chemical traffic, particularly along the waterways of the Gulf Coast. The trend toward greater use of imported steel will mean greater waterways movement of this commodity. Export of U.S. steam coal may be even greater than previously anticipated. A report issued in May 1980 by the World Coal Study, *Coal: Bridge to the Future,* forecast U.S. coal exports of between 150 million and 240 million tons by the year 2000, compared with the record 65 million tons expected this year.

The Maritime Administration's Mid-America Ports Study came up with similar conclusions, and projected a doubling of inland waterborne commerce by the year 2000.(See related article in this issue.) Under the methodology used in this study, the following barge-carried commodities were expected to experience high growth by the turn of the century: grain (up 80 percent), coal (127 percent), petroleum products (75 percent), fertilizers (446 percent), and chemicals (108 percent).

Since the release of the Mid-America Ports Study in May 1979, there has been an unprecedented increase in interest in U.S. coal among foreign buyers. Spurred by skyrocketing oil prices, other countries have started turning to this alternative source of energy. U.S. exports of steam coal during the first half of 1980 increased nearly eightfold compared to the first half of 1979.



(Iowa State Department of Transportation)

Another recent development expected to impact on the barge industry was the signing last October of a grain agreement between the United States and the People's Republic of China. It calls for the PRC to purchase at least six million metric tons of U.S. grain annually from 1981 to 1984.

It is obvious that the inland waterways industry will be called upon as never before in the next two decades to haul commodities essential to this nation's economy and its strategic position in the world. The central question is whether the industry will be allowed to do the job—or be stifled by various constraints.

The barge and towing industry has earned an excellent reputation for being responsive to the needs of America's shippers and consumers. It is fuel-efficient, cost-effective, highly productive, and available for America to use. The American waterways operators would like to see it kept that way.

During the recent campaign, President Reagan pledged that "a strong and healthy domestic water transportation system—barges, towboats, waterways and locks—is absolutely essential to the American economy." The American Waterways Operators, Inc., expects to use every resource at its disposal to assist in implementing that pledge ■

Winter Shipping Impact On Environment

by Charles R. Liston

An earlier *Water Spectrum* article (Winter 1979) outlined the Great Lakes winter navigation program. This "Short Take" highlights an environmental study undertaken in connection with that program.

In 1970, Congress authorized the United States Army Corps of Engineers to conduct a 10-year winter shipping demonstration program on the Great Lakes. If proven environmentally, economically, and socially acceptable, this program could result in large-scale modifications of various connecting channels, locks, and ports along the Great Lakes transportation system. Along the upper four lakes alone (Superior, Michigan, Huron, and Erie), these modifications could significantly affect the environment of some 36 harbors plus the locks at Sault Ste. Marie and several critical "bottleneck" zones (connecting channels) including the St. Marys River, the Straits of Mackinaw, and the St. Clair River—Lake St. Clair—Detroit River system. Alterations might include the dredging of deeper and wider channels, installation of ice booms and ice bubbler systems and placement of underwater dams. Unnatural wintertime turbulence would result from ice breaking and ship movements.

short take

Although a decade of data gathering has produced a comprehensive report detailing the technical and economic feasibility of an extended navigation season, there is a large vacuum in our knowledge of what this proposed program might do to the biological systems of the Great Lakes. The connecting channels are of special concern. As often happens, there exists little basic research that may be relied upon to predict environmental effects of a major alteration of an aquatic ecosystem.

Now underway is a cooperative research venture involving the Department of Fisheries and Wildlife at Michigan State University (MSU), the U.S. Fish and Wildlife Service, the Michigan Department of Natural Resources, and the U.S. Army Corps of Engineers.

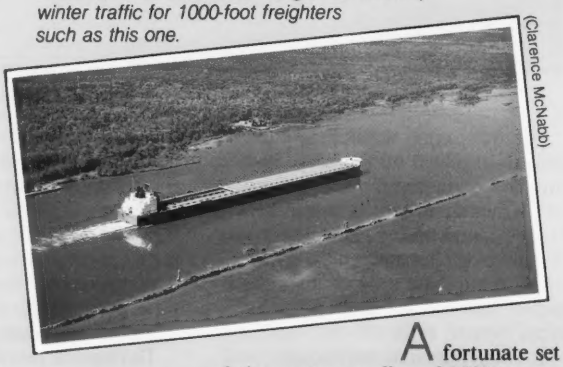
Dr. Liston is an associate professor in the Department of Fisheries and Wildlife, Michigan State University, East Lansing 48824.

Funding is provided by the Corps, contractual arrangements and research directions by the Fish and Wildlife Service. The Department of Natural Resources directs research and influences study designs, while the university designs the studies, collects the field data, and writes the reports. Studies include the chemistry of involved water and sediments, aquatic plants, fish food organisms (mainly invertebrates associated with sediments), and all life stages of fish (i.e., egg, larva, juvenile and adult). Target sites are on a 17-mile stretch of the St. Marys River near Neebish Island, Michigan, about 20 river miles below Sault Ste. Marie, Michigan.

The St. Marys River, some 75 miles long, provides the single outlet channel and shipping connection between Lake Superior and all lower Great Lakes. The river and its many backwater bays and lakes contain a great diversity of plant and animal life and provide excellent habitat for valuable fish species such as cisco, walleye, yellow perch, and northern pike.

Because of the biological richness of the river and heightened environmental concerns that evolved during the latter stages of the winter navigation demonstration program, funds were made available in late 1978 for baseline data gathering in areas of special impact potential, such as the narrow and twisting channels around Neebish Island.

Summertime view of the St. Marys River Middle Neebish Channel, which would be dredged for two-way winter traffic for 1000-foot freighters such as this one.



(Clarence McNabb)

A fortunate set of circumstances allowed MSU to apply successfully for these studies. Though 300 miles from campus, selected study sites were within several miles of a university forestry facility, known as the Dunbar Research Station, that happened to have a safe harbor and direct connection by water to the St. Marys River. With much field and laboratory equipment transferred from past Great Lakes projects, a portion of the forestry station took on the appearance of an aquatic laboratory.

The research is being conducted by two faculty members, several on-site research biologists seasoned on the Great Lakes, graduate students, and undergraduate interns. This blending allows for gathering accurate, replicated field data while training new field-oriented aquatic biologists.

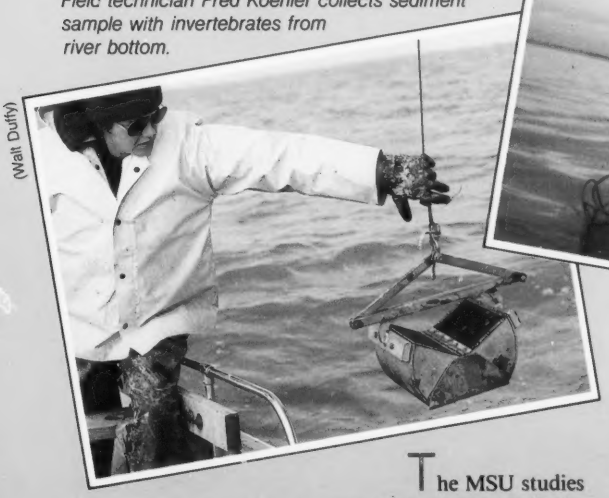
The MSU group has had to concentrate on more than the intensive application of conventional research

gear in the St. Marys. Proposals for winter navigation have made biologists suddenly aware that practically no information exists on fish abundance, distribution, and behavior under the ice. New research techniques have had to be developed, and the field biologists, adapted to spring, summer, and fall weather on the water, now face below-zero temperatures, snowmobiles instead of boats, and ice augers plus other pertinent winter gear for dropping nets and various sampling devices under the ice. They also face the uncertainties of attempting to sample fish in river channels that are sporadically opened with Coast Guard icebreakers. We have learned a great deal about the rigors of under-ice sampling the past two years; the winter work has been successful and will be expanded. The key to success is maintaining a "minuteman" program where field people stay near the site and are constantly prepared to take advantage of the elusive "good" winter weather at this latitude.

(Walt Duffy)

Sampling fish species with electrofishing gear in shoreline waters of the St. Marys. Author is second from left.

Field technician Fred Koehler collects sediment sample with invertebrates from river bottom.



(Walt Duffy)

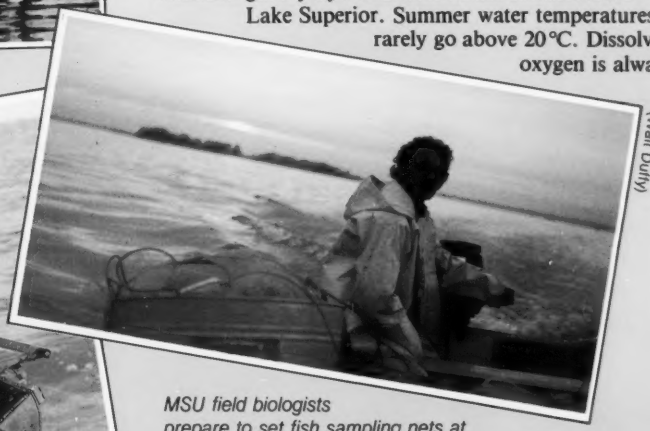
The MSU studies were contracted initially for February 1979–April 1980, then extended through January 1981, and now broadened and funded through March 1982. The goals of these studies have a central theme: to glean information from the St. Marys that will help assess environmental disturbances associated with proposed winter navigation.

A comprehensive report involving all data taken during the initial study has been completed by MSU and is now being reprinted for general distribution by the Corps' Detroit District. A total of 47 species of fish were found in the St. Marys, a considerable increase over previous species lists. Adult fish collections were dominated by white sucker, northern pike, yellow perch, rainbow smelt, cisco, walleye and rock bass. Juvenile fish of many species utilize the shallow water and vegetated shorelines, areas of particular concern because of possible increased erosion from shifting ice. Larval fish studies indicated that a minimum of 18 species use these river stretches for spawning.

Bottom invertebrates, many of which are eaten by fish, were diverse (134 different types were identified), and off-channel densities ranged as high as 33,969 individuals per square meter of substrate. In-channel densities were lower with maximums of 6376 per square meter.

Aquatic plant beds, environments used by invertebrates and early life stages of fish for food and protection, are prominent components of the St. Marys. Zonation of aquatic plant meadows is being determined and species composition and biomass recorded. Future MS and Ph.D. theses will focus on the intricate interactions between aquatic plants and the small animals they harbor. Such concentrated efforts often provide fresh insight into solving problems related to impact assessment.

Water quality in the St. Marys is high and is influenced greatly by conditions in the outflow from Lake Superior. Summer water temperatures rarely go above 20°C. Dissolved oxygen is always abundant, ranging from 9 to 13 parts per million.



(Walt Duffy)

MSU field biologists prepare to set fish sampling nets at sundown on the St. Marys.

All field data are quantified and gathered by standard procedures conducive to future replication. Such designs can shed light on natural annual variations of biological systems as well as allow for direct comparisons between "before and after" impact studies.

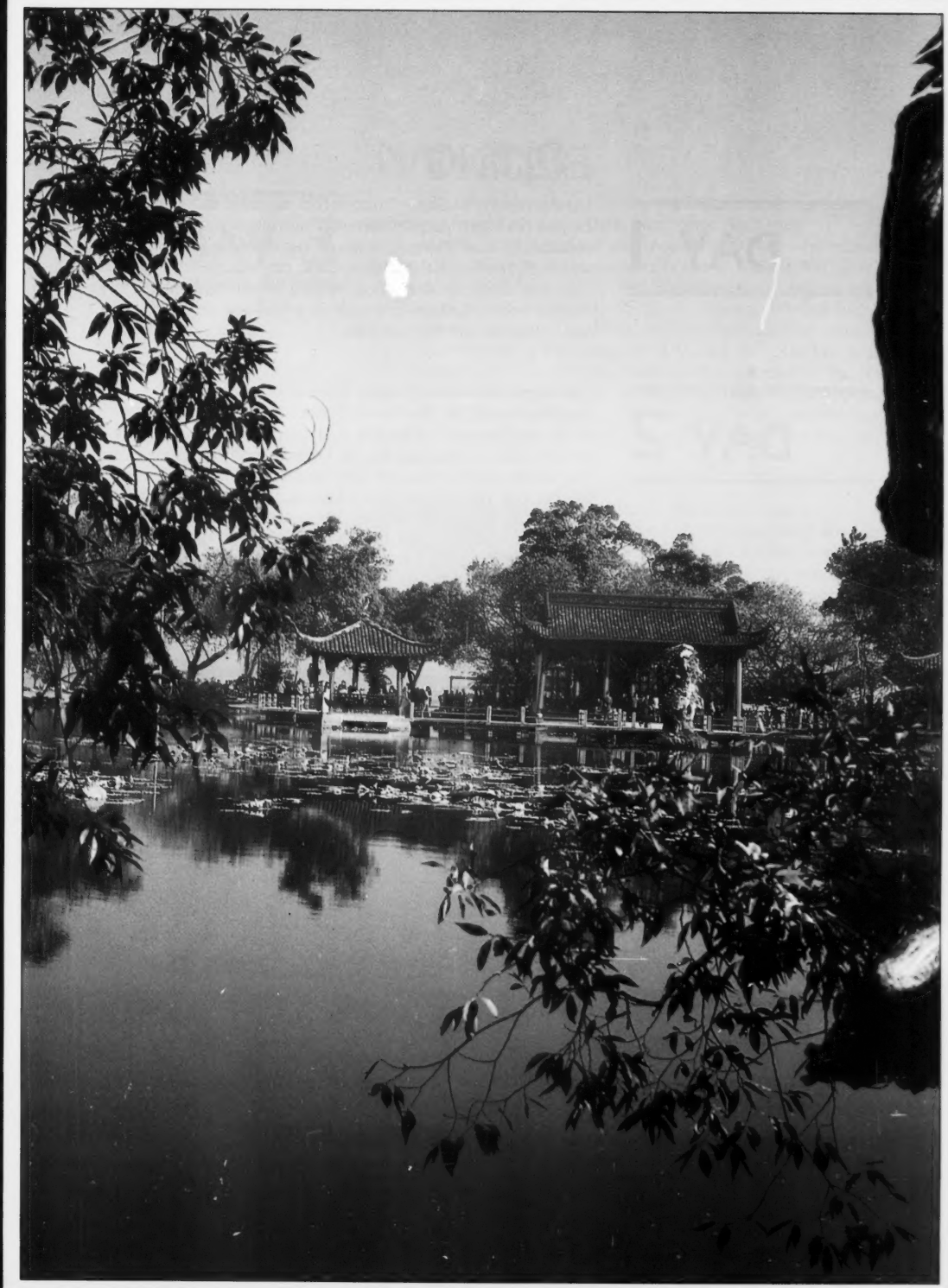
The 1981 winter season will provide the best chance for gathering winter data since the demonstration program began in 1970. The MSU study is concentrating on "under-ice" work this year and hopes to gather more information during the 1982 winter. ■

China Journal

by Bob Norton

(Editor's note: The U.S. Army Corps of Engineers became involved with the People's Republic of China under the auspices of the Science and Technology Agreement (S&TA) signed by then President Carter and Chinese government officials in January 1979. The S&TA was further defined in August 1979 with the signing of the Mondale Protocol, which delineated U.S.-PRC cooperation in hydroelectric power generation. In response to that Protocol, a U.S. delegation composed of representatives from the Department of Energy, the Tennessee Valley Authority, the Water, Power and Resource Service and the U.S. Army Corps of Engineers visited China in March 1980. During that visit, an Annex for the Protocol was developed which described future U.S. and PRC activities related to hydropower and related water resource development. Among those activities, the Corps of Engineers was assigned to review the multi-purpose development of the Hongshui River, to review the economics and design of Longtan Dam, and to study the regulation of the Yangtze River Estuary. The first Corps' team to visit China under the terms of the Annex to the Protocol arrived last October and was concerned with the Yangtze Estuary. This group, technical experts from the Corps' Lower Mississippi Valley Division and experienced with Mississippi River problems similar to those being encountered along the Yangtze, included Henry R. Schorr, Cecil Soileau and Thomas Pullen of the New Orleans District; Michael J. Trawle of the Waterways Experiment Station; and Claude Strauser of the St. Louis District. Lloyd A. Duscha, Chief of Engineering Division, Office of the Chief of Engineers, acted as delegation leader. The author accompanied the team to record the visit for Water Spectrum *magazine, and the following is a journalized account combining his observations and the team's trip report:)*

Mr. Norton is editor-in-chief of *Water Spectrum.*



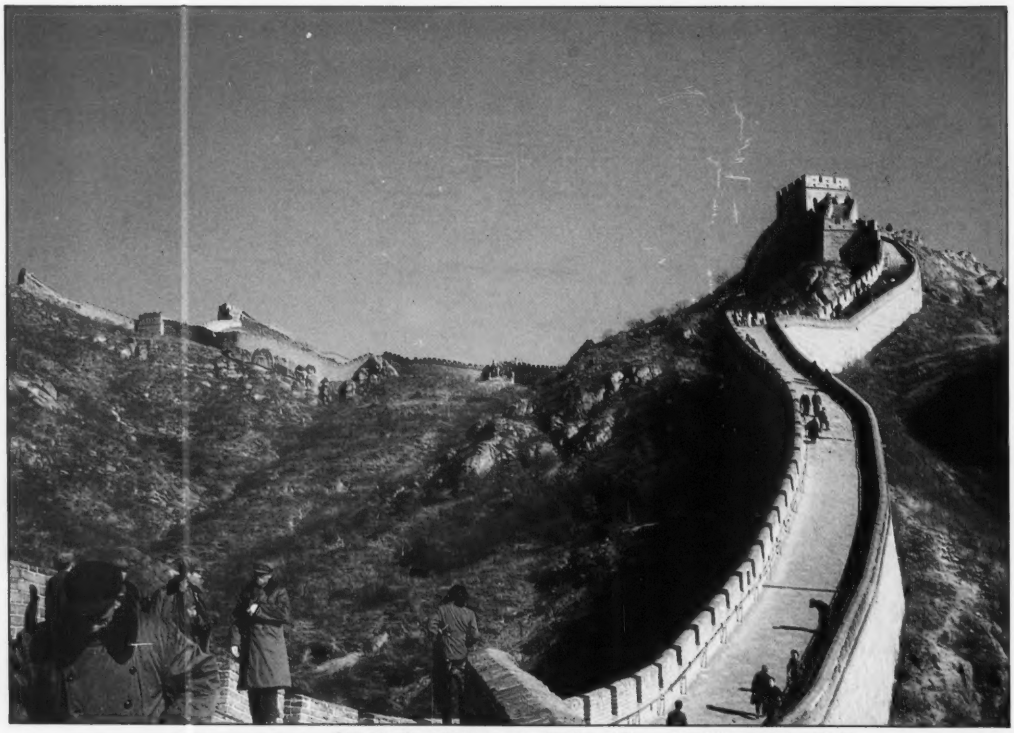
BEIJING

DAY 1

Landed briefly at Shanghai to refuel en route to Beijing (Peking). Airport seemed disproportionately small considering that Shanghai is about the third largest city in the world. Arrived in Beijing after dark; city was heavily blanketed with coal smoke as the winter heating season had already begun this far north. Lodged overnight in a building originally used to house Russian advisory groups.

DAY 2

The team met with a Chinese delegation headed by the Director of the Bureau of Science and Technology to discuss the team's schedule and functions while in China. We would work six days a week, in keeping with the Chinese practice, and would reserve Sundays for sightseeing. Following a trip to the Beijing Zoo for the obligatory look at the pandas, and a brief tour of the Temple of Heaven, the team attended a luncheon hosted by Madame Guo Jian, Vice-minister of Communications, then boarded a train for an 18-hour trip south to Nanjing (Nanking) and the Yangtze River.



China's Great Wall, near Beijing. (Photo by Mike Trawle, CofE.)

NANJING

DAY 3

Arrived at our billets in the outskirts of Nanjing where we would spend the next eight days. Two men to a room in rather spacious accommodations that were purported to have originally been the summer home of Chiang Kai Shek's wife during the Chinese Civil War. Weather warm and sunny, as we were at about the latitude of central Florida. We had two PRC government interpreters with us, and even brought our own—Mr. Fang Tian-Zhong, a PRC engineer who had spent the last year training with the New Orleans District. Met the staff of the Nanjing Hydraulic Research Institute, led by China's senior hydraulic engineer Mr. Huang Sheng, and began a series of presentations by the Chinese engineers on the Yangtze Estuary and the Port of Shanghai.

DAY 4

Briefings continued at the Institute. After each aspect of the estuarine problem was presented, we were taken to the Institute's basin model so that we could visualize how the problem looked "on the ground." The Institute was established in 1935, and currently houses Departments of Engineering Hydraulics, River and Harbor, Soil Mechanics and Construction Materials. The facilities include hydraulic, geotechnical and structural laboratories and a technical information center. The Institute employs about 750 people, of whom nearly 400 are engineers and professionals.

Mike Trawle of the Corps' Waterways Experiment Station studies a current velocity measuring device at the Nanjing Hydraulic Research Institute's Yangtze River Estuary Model.

The American and Chinese engineers on the floor of the Nanjing Hydraulic Institute's Yangtze River Estuary Model.

DAY 5

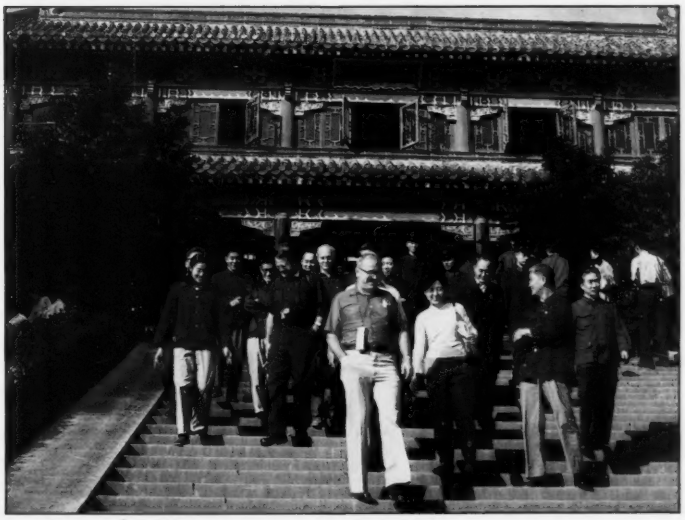
Up at dawn as usual. Supposedly our "free day," but our Chinese hosts had scheduled a full day of sightseeing. We climbed up to the tomb area of the first king of the Ming Dynasty. The site was virtually destroyed during the Cultural Revolution, but is being restored. The exact location of the grave is not yet known to archeologists. Other highlights were the mausoleum of Sun Yat Sen, and the Nanjing Zoo. The day also afforded the American delegation its first look at the Yangtze River from a very comfortable tour boat. We were taken on a guided tour of one of China's most prideful post-Liberation (1949) monuments—the Nanjing Bridge spanning the Yangtze. It was pointed out to us that this crucial north-south rail link was erected by the Chinese after Russian advisors in the 1950s had given up trying to span the river at this point due to depth and current velocity. The evening was spent in planning lectures that the American experts were to deliver at the Institute on days nine and ten.

DAY 6

Introductory briefings continued and we were walked through the estuary models. The Chinese told us the objectives of the estuary model testing were to study ways of assuring a deepwater channel adjacent to the massive steel plant being constructed on the Yangtze at Baoshan, sedimentation control in Shanghai Harbor, diffusion of wastewater, and overall river navigation projects and water pollution control. In the evening, another great meal back at our billets. The food was all Chinese, plentiful and delicious, and we were becoming very adept with chopsticks. Our standard post-dinner meeting was spent in reviewing the day's activities and working on what would become the team's official trip report.

DAY 7

Henry Schorr was keeping his early promise to learn "at least four" Chinese characters (ideograms) a day, much to the amusement of the Chinese delegation. In the morning we separated into similar interest groups for detailed discussions between the two teams. Schorr and Tom Pullen met with Chinese engineers concerned with dredging and environmental considerations thereof, Mike Trawle with the estuary modelers, and Cecil Soileau and Claude Strauser with the Chinese training works design and construction engineers. In the afternoon we reformed into a full group and toured the Institute's labs—among them stress testing, soil compaction, corrosion forces and coatings. Two of the lab chiefs were women. In the evening we had a brief shopping spree in downtown Nanjing, where we purchased Chinese army and "Mao" caps and drew large, friendly crowds wanting to practice their English. News of the outside world was very difficult to get, and we spent the evening huddled around a shortwave radio trying in vain to find out about the American Presidential race polls and the World Series.



The American team adopted the host nation's six-day workweek during its month in the People's Republic of China. The days off were normally spent visiting China's numerous tourist attractions, such as this ancient temple near Nanjing.

Corps dredging expert Henry Schorr makes a point to his Chinese counterpart during technical discussions on Yangtze River Estuary control at the Nanjing Hydraulic Research Institute.

DAY 8

Throughout the earlier Chinese briefings, the Nanjing engineers had presented three separate schemes under consideration for training the estuary, and, after each scheme was chalkboarded, we saw it in operation in the model, then discussed its advantages and disadvantages. At the request of the Chinese, the American team today presented its alternative scheme—recommending development of the north channel of the south branch of the river. This route would require less long-term maintenance because of the direction of littoral drift across the estuary and because the shorter distance across the bar to deep water in the open sea will facilitate future deepening. Additionally, the American engineers felt that the south channel of the south branch was the major sediment carrier. The U.S. team was constrained by not having access to Chinese data bases in arriving at its plan, and by the necessity to attempt in three days what the Chinese have worked on for years. The American plan caused some animated discussion because of an existing disagreement between the Shanghai Waterway Bureau engineers and those from the Institute as to which channel to concentrate on. The U.S. team suggested that a segmented moveable bed model should be constructed to focus on the points of disagreement over the training structures required to achieve the project objectives of the American plan.

DAY 9

The American technical presentations began with Henry Schorr discussing the history of the Mississippi from Baton Rouge to the Gulf Navigation Project, Cecil Soileau the history of regulatory training efforts on the Mississippi Estuary and new proposals undergoing model testing, and Claude Strauser the history of training shorelines and sedimentation problems along the river. Claude was the fashion hit of the day, when he wore his blue "Mao" jacket at the podium. At night we were taken to a lavishly costumed stage show in the Nanjing Theater.

DAY 10

Our presentations to the Chinese continued. Mike Trawle spoke on field data collection for use in model testing and on the Chinese need to introduce salinity modeling and more advanced computer modeling into their testing program. Tom Pullen talked about environmental protection and enhancement along the lower Mississippi River, and its adjacent marshlands, and fielded questions from the Chinese side on their problem of trying to preserve a valuable fishery in the same area of the estuary where large amounts of dredging may be required. (Tom had an extremely bad cold at this point and was being sustained by copius quantities of hot Chinese tea.) Mr. Fang spoke on his experiences with the Corps during his year in New Orleans. Our last night in our "home away from home," and the kitchen staff prepared us a superb meal.

DAY 11

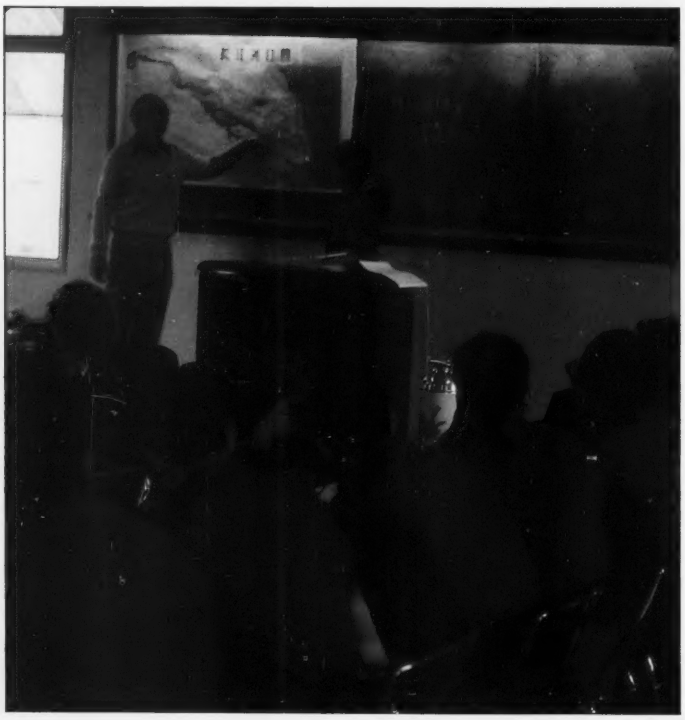
Back on the railroad en route to Hangzhou, with a midday stopover in Shanghai. Saw China's famous "leaning pagoda" from the train window. Had lunch, following some difficulty between the Beijing dialect of our interpreters and the Shanghai dialect of the restaurant staff. Took a brief tour of Shanghai after lunch and walked through a former dynasty official's private and quiet garden in the center of the noisy city. Had the obligatory tea on furniture more than two hundred years old! The garden and pavilion-like buildings had also been heavily damaged during the Cultural Revolution, and we were beginning to understand the enormity of that period. Each of our Chinese hosts had his own horror story about the hardships he endured at the hands of the rampaging student revolutionaries. We reboarded the train and arrived after dark in Hangzhou. Put up in a huge hotel that had earlier served Soviet guests; the signs were still in Chinese and Russian, with English hastily added. We were told that the hotel overlooks China's fabled West Lake. We were at the approximate latitude of Tampa or Galveston, but it was very cold. (Hangzhou was one of the Chinese cities extolled by Marco Polo.)

The Corps of Engineers delegation shares an informal moment with its Chinese engineering counterparts.

HANGZHOU

DAY 12

Another free day. Got up even earlier than usual and took a dawn boat ride on West Lake. Several of us agreed that it was the most beautiful sight we had ever seen—pavilions behind willows on every point, and stone pagodas back from the lake on the high ground. Walked through many temples in the city's suburbs, and visited the botanical gardens. Shopped in the "Friendship Store" that every city has for foreigners. Most of us purchased silk bolts and dolls in native folk-dress. I debated the purchase of a pair of "costume" earrings until I translated the price tag from Chinese yuan into American dollars and found that they were antique gold and jade and cost $6,000. In the evening, back at the hotel, an official from the Provincial Water Conservancy Bureau presented an illustrated briefing on the tidal bore which occurs in the nearby Qiantang Estuary. We were given a description of the problems associated with the bore, current and proposed reclamation projects in Hangzhou Bay, and a description of a proposed barrier to the bore and locks to control it and insure continued navigation from the sea to the river. The American team was asked to provide comments on how the bore could be diminished or controlled. None of the American engineers had ever seen a major tidal bore but most had some textbook knowledge of the hydraulics involved.



Mike Trawle, of the Corps' Waterways Experiment Station, addresses engineers and scientists at the Nanjing Hydraulic Research Institute during his presentation on field data collection for use in model testing. Each of the American experts gave a half-day technical talk on his area of expertise.

A juxtaposition of old and new waterborne commerce along the Whangpoo River and Shanghai waterfront. (Photo by Claude Strauser, CofE.)

DAY 13

Toured Hangzhou University research labs after a general orientation by the University vice-president on the school's history and purpose. Primarily a teacher's university, it has a strong research interest in estuarine and coastal processes because of its proximity to the China Sea. At the University the team saw the sedimentology lab and a hydraulic estuary model. Next, the U.S. delegation visited the National Bureau of Oceanography to view a movie showing the tidal bore and the historical and recent efforts to regulate it and reclaim land. In the afternoon, the team traveled out about 60 kilometers to watch the bore come in. It first appears as a thin white line far downriver, the noise growing louder as the bore approaches and its height above the river level becomes apparent. Finally, the wall of water literally explodes high against the training dikes. Truly, the Hydraulic Wonder of the World. (Our hosts told us that 50,000 hectares of critically needed farmland have been reclaimed behind the dikes since 1950.) Throughout China's history, thousands have been killed by the bore. Its basic cause (a tidal buildup behind a river mouth sandbar) was recognized by Chinese intellectuals 2,000 years ago. A long, long day, but the natural phenomenon of the bore was well worth it.

SHANGHAI

DAY 14

Early departure by train for Shanghai where we would spend the remainder of the trip. Talked with a venerable Chinese gentleman aboard who said he had graduated from Penn State in 1945 and had a daughter currently attending UCLA. He said he "wasn't a politician, just an old coal miner." Found out later he was very highly placed in China's Ministry of Coal. The train made an emergency stop for some never-explained reason and a couple of the American engineers got painful spills of hot tea. We checked into Shanghai's supposedly finest hotel, and Schorr, Strauser and the author went on a 30-block, unescorted walk to Shanghai's shopping center. We met numerous helpful, English-speaking Chinese who interrupted their shopping to help us with ours.

DAY 15

October 29, and we got our first look at the Yangtze Estuary in the flesh. Daylong ride on a hopper dredge, with the river as smooth as glass, and an excellent meal aboard. The trip began at the confluence of the Whangpoo and Yangtze Rivers and proceeded seaward to the lower estuary along the north channel. The estuary was shallow in places and it was necessary to take advantage of the high tide to insure adequate depths. In the evening the Corps of Engineers delegation attended a dinner hosted by the Waterway Conservancy Bureau and met with the mayor of Shanghai.

Huang Sheng, deputy director of the Nanjing Hydraulic Research Institute and China's senior hydraulic engineer, briefs the Corps of Engineers team on problems encountered in Yangtze River Estuary control.

DAY 16

A second trip into the estuary. On this occasion, the boat left downtown Shanghai and carried the team down the Whangpoo and through the Port of Shanghai. Once into the estuary proper, the vessel went upstream past the Baoshan Steel Mill construction site and into the area where the Chinese propose to construct the initial regulation work. Both the port and river area are very congested and the Chinese engineers recognize that only limited additional development is practical.

DAY 17

Today the Americans were taken to two hopper dredges at anchor in the Whangpoo River channel. Both dredges were constructed in Japan and have been in Chinese waters since January and September 1979, respectively.

Inside the pilot house of one of the three Chinese dredges the American delegation visited in the Yangtze River Estuary. (Photo by Mike Trawle, CofE.)

DAYS 18-24

The week was spent in meetings between the two delegations to exchange information and experiences. As the lead Chinese agency was at this point the Shanghai Waterway Bureau, and not the more pure research-oriented Nanjing Institute, there was a shift in the theme of discussions, and survey methods and equipment were discussed. The Chinese were especially interested in organization and in functions of organizational elements involved in project management. They were concerned about the computation of dredge rental rates, staffing of dredges and organizational command lines. Discussions between the two delegations indicated that, because of the long haul distances necessary to transport the dredge material to deep water in the China Sea, the material is disposed of in the estuary, relatively near the channel. Sediment transport studies, using radioactive tracer elements, have showed that only a small amount of material returns to the channel. Conditions in the Yangtze Estuary preclude the effective use of other than hopper dredges. With such a large dredging and pumpout capability as the Chinese have (13 hopper dredges under the control of the Shanghai Waterway Bureau), the Americans felt that much of the material might be used to build islands. These islands could serve as anchors for the training works, assist in the channelization of the estuary, and be used for port facilities. The Chinese delegation was aware of the need for environmental protection and was particularly interested in learning more about effects and control of pollution. They wanted to identify possible harmful effects of dredged material disposal practices and to learn more about American environmental protection laws and regulations. A severe pollution problem is acknowledged to exist already in the estuary, and it will become worse as additional industrial complexes—such as the Baoshan Steel Plant—come on line.

Industrial development along the Yangtze River near Nanjing. The river was spanned by Chinese engineers after Russian advisors had said it was impossible at this point due to depth and current velocity.

DAY 25

Today the American team presented lectures to approximately 200 Chinese engineers and scientists from the Shanghai Hall of Science. Mike Trawle spoke on the San Francisco Bay Model, Claude Strauser on ongoing potamology (the study of rivers), Henry Schorr on the Mississippi River deep water channel, Cecil Soileau on the design and maintenance of jetties and breakwaters, and Tom Pullen on the Atchafalaya River Estuary.

DAY 26

Our final "free day" in-country, spent shopping and sightseeing. Henry Schorr had enough silk to make shirts for the entire Tulane football team, and all our suitcases were bulging with souvenirs. Everybody was more than ready to wrap it up and head home.

One of the ubiquitous pagodas that dot the Chinese countryside. This one is in Suzhou, west of Shanghai. (Photo by Mike Trawle, CofE.)

DAYS 26-27

Two days of summations by both delegations. All the directors of the various Chinese agencies we had talked with were in attendance. The American team made three suggestions they considered essential to accomplish the Chinese objectives in the development of the Yangtze Estuary:

■ Overall management and responsibility for the project should be placed in the hands of a single project manager.

■ An overall plan should be formulated and then pursued, and it should be flexible enough to incorporate changes as conditions warrant.

■ Continuing laboratory research and field investigation should be carried out, in order to insure that goals are being achieved and to monitor changes that are being experienced in the estuary.

More specific technical recommendations included:

- For economic reasons, maintenance of the north channel of the south branch to the sea is most desirable.
- A dike opposite the Baoshan Plant is necessary for long-term channel dependability regardless of which channel is selected.
- The flow in the north branch of the estuary should be maintained and monitored.
- Further study is needed prior to construction of training works upstream from the steel plant, while effects of the dike can be determined.
- Construction of islands from dredged material should be investigated.
- Any future port development should be in the estuary and not in the Whangpoo River.
- Salinity modeling would be beneficial to the ongoing study, and new model boundaries should be extended to include the entire north branch.

In final summation, the Chinese expressed an interest in visiting the Corps' Waterways Experiment Station, the San Francisco Bay Model, the Chesapeake Bay Model and the Coastal Engineering Research Center, and in making field trips to the Mississippi River Passes, Mobile Bay and Atchafalaya Bay, as part of their trip to the U.S. under Article 6.2 of the Annex to the Mondale Protocol.

The Chinese are interested particularly in discussing management concepts, dredging methodology, jetty and dike construction and maintenance, wetland development and dredge material disposal methods, environmental considerations in project development and maintenance, field surveying and investigative techniques, contract specifications and contract management.

DAY 28

The American delegation left China. ■

Events, Deeds & Deliberations

NEW WETLANDS CLASSIFICATION SYSTEM

The U.S. Fish and Wildlife Service has developed a new wetlands classification system that it hopes will be adopted for use by other Federal and state agencies concerned with the protection of these vital areas.

Once thought of as wastelands, wetland areas today are recognized for their value in maintaining groundwater supplies, purifying water, preventing shoreline and bank erosion, and temporarily storing floodwaters. In addition, biologists have long realized the critical importance of this habitat to the continued existence of fish and wildlife species.

A standardized system of classifying wetlands will enable improved resource management decisions by the public agencies that are responsible for their protection. Such a new system is profiled in a recent publication by the Fish and Wildlife Service entitled *Classification of Wetlands and Deepwater Habitats of the United States*, developed in conjunction with the U.S. Geological Survey, National Oceanic and Atmospheric Administration, and the University of Rhode Island.

In defining the biological boundaries of wetlands, the new system allows Federal and state agencies, as well as the private sector, to describe and categorize these types of habitat. This information is essential in the early planning stages of any project and may prevent costly and unexpected delays during the construction stage.

Once a developer contemplates a project within or adjacent to a wetland, the classification system provides the information necessary to gauge the habitats' characteristics. The appropriate local, state, or Federal agencies can then advise whether it may fall under their jurisdiction and determine what, if any, regulations might apply to modifications to that area. In the design of this system, however, there is no attempt to establish the boundaries of the regulatory programs of local, state, and Federal agencies.

Wetlands are recognized as the most biologically productive type of ecosystem in the world. They include a variety of diverse types, among them marine (open ocean and associated coastlines), estuarine (salt marshes and brackish tidal waters), riverine (rivers, creeks, and streams), lacustrine (lakes and deep ponds), and palustrine (small ponds, prairie potholes, marshes, swamps, and bogs).

Wetlands are economically important—two-thirds of the commercially important fish and shellfish harvested along the Atlantic and Gulf coasts depend on coastal estuaries and wetlands for food, spawning grounds, or nurseries for their young; for the Pacific coast, that figure is nearly one-half.

The Service's new classification system replaces an earlier one, in use since 1954, whose original purpose was to assess the amount of waterfowl habitat on the basis of 20 different types of wetlands. Presented in a document known as *Circular 39*, this had been one of the most commonly used systems in the effort to preserve valuable, but diminishing, wetlands throughout the United States. The new classification scheme is broader and more inclusive in the types of information it presents.

"The classification system we've developed now gives a lot more attention to wetlands that have *other* values, not just wetlands that have value as waterfowl habitat," says Lynn Greenwalt, director of the Fish and Wildlife Service. "Such factors as dominant animal and plant life, soil type, and water chemistry are all now incorporated in the way we look at, define, and group wetlands."

The new system is designed to meet four main objectives:

- To describe areas that have similar natural attributes;
- To arrange these areas in a system that will enable better resource management decisions to be made;
- To convert these areas into a format for inventory and mapping; and

- To provide a uniform classification system and terminology.

Already the State of Michigan has adopted the Service's new classification system as its method of classifying wetlands, and the new system is being used by the Fish and Wildlife Service as the basis for its National Wetlands Inventory.

Classification of Wetlands and Deepwater Habitats of the United States is available for $4.25 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (stock no. 024-010-00524-6). ■

ARCHEOLOGICAL RESOURCES PROTECTION

Proposed regulations establishing uniform procedures for Federal land managers to protect and conserve archeological resources on public and Indian lands have been published in the Federal Register of January 19, 1981.

The proposed regulations would implement the Archaeological Resources Protection Act (P.L. 96-95) which was signed by former President Carter on October 31, 1979.

The Archeological Resources Protection Act has two major purposes:

- To protect irreplaceable archeological resources on public and Indian lands which are subject to loss or destruction by persons who excavate, remove, damage, alter or deface them for commercial or personal reasons, and
- To increase communication and exchange of information among government authorities, the professional archeological community, Native Americans, collectors, and the general public toward the goal of protecting and conserving archeological resources nationwide.

Three major issues are covered in the regulations:

—Archeological resources are defined as material remains of human life or activities at least 100 years old of archeological interest. As authorized by Congress, the regulations expand the Act's definition of archeological resource to clarify it.

—Permits will be issued by Federal land managers for the excavation or removal of archeological resources. Excavation and removal must be done in the public interest by qualified persons. Archeological resources located on public, non-Indian lands are the corporate property of the nation, held in trust by the Federal government. Archeological resources located on Indian lands remain the property of the Indian tribe or Indian individual having rights of ownership over those lands.

—Persons who receive permits to excavate archeological resources must guarantee that the resource and associated scientific data removed from public or Indian lands receive adequate care and are maintained for the benefit of the public and scientific study. A permit for the excavation or removal of archeological resources on Indian lands may be issued only after consent from the appropriate tribal authority or Indian landowner with direct legal jurisdiction over the lands proposed to be excavated.

Prior to issuing a permit for the excavation or removal of archeological resources located on public, non-Indian lands, the Federal land manager is responsible for advising and considering comments from Indian tribal authorities or Indian groups which may have an interest in the resources for cultural or religious purposes. Federal land managers may suspend, revoke, or terminate any permit.

Criminal penalties for violations of the Act can range from a fine of not more than $10,000 and/or imprisonment of not more than one year to a fine of $100,000 and five years in jail.

The proposed regulations were written by an Interagency Task Force of representatives of the Departments of Defense and Agriculture, the Tennessee Valley Authority, and bureaus of the Department of the Interior. ■

INCREASED FLOW IN TRINITY TO AID SALMON

Acting to reverse the serious decline in salmon and steelhead in California's Klamath/Trinity area, former Secretary of the Interior Cecil D. Andrus on January 16 announced a permanent increase in the water flow in the Trinity River to a major spawning and rearing area below Lewiston Dam.

Last spring, Andrus temporarily increased the flow from 120,500 acre-feet annually to 287,000. This will now become permanent and will be gradually increased to 340,000 acre-feet in normal years.

Chinook runs have dropped by 80 percent and steelhead by 60 percent since the Trinity River Division water project, completed in 1964, blocked access to over 100 miles of fishery habitat. Since that time surveys indicate that remaining fishery habitat has been reduced by 80 to 90 percent, primarily from excessive stream sedimentation and inadequate streamflow. Logging, road construction, and heavy fish harvest rates have also contributed to fishery losses.

Fishery experts believe that intensive streambed and watershed rehabilitation, combined with increased streamflow, are the only hope for preventing the fish

from becoming extinct in the river system. Good chinook and steelhead runs also will greatly benefit the Hupa and Yurok peoples who depend upon these fish for their ceremonial and subsistence needs and for commercial purposes. Indian fishing on the Hoopa Valley Indian Reservation has been regulated since 1977 by the Department of the Interior, which placed a moratorium on commercial fishing in 1979 and 1980 to ensure adequate fall chinook spawner escapement. ■

RECREATION VISITS UP

The Corps of Engineers welcomed more than 457 million visitors to its lakeside recreation areas in 1980, an increase of six million over the previous year. ■

NONSTRUCTURAL SOLUTION—SMALL FLOOD CONTROL PROJECT

The Corps of Engineers' Los Angeles District has completed its detailed project report of flood damage reduction for Allenville, Arizona, under Section 205 of the Continuing Authorities Program. The Office of the Chief of Engineers approved the report in July 1980, with construction to begin in December 1980 or January 1981. This is the first use of the Small Flood Control Project Authority for a nonstructural project.

Allenville, 35 miles west of Phoenix, is located in the floodway and fringe of the Gila River and has been damaged extensively by three floods in the past three years. The project provides for the construction of a replacement community for 35 families who have elected to resettle approximately eight miles from their flood-ravaged homes. All structures in Allenville will be razed as part of the project, and the lands will be provided to the State Fish and Game Department for management. ■

Bookshelf

Principles of Desalination, edited by K.S. Spiegler and A.D.K. Laird, is a two-volume set available from Academic Press, Inc., 111 Fifth Avenue, New York, NY 10003 for $41.00. Sample chapter headings include Fundamentals of Distillation, Design of Distilling Plants, Preparation of Ultrapure Water, and Properties of Sea Water. 821 pages with index.

Energy Development in the Southwest: Problems of Water, Fish and Wildlife in the Upper Colorado River Basin, edited by Walter O. Spofford, Jr., Alfred L. Parker, and Allen V. Kneese, is a research paper that provides a basic understanding of the impacts of development and the nature and scope of the trade-offs between energy exploitation and protection of water-related natural resources. This collective study, combining the work of 54 authors and discussants, is intended for those in the research community interested in issues of natural resources, fish and wildlife agencies, and public and private decision makers who must help forge policy concerning resource management. This informative two-volume set, published by Resources for the Future, is available for $25.00 from The Johns Hopkins University Press, Baltimore, MD 21218.

Proceedings of the Twelfth Dredging Seminar, by J.B. Herbich, is a 400-page book that includes all presentations discussed at the seminar. Among the presentations were Measurement and Prediction of Consolidation of Dredged Material, Early Dredging on the Texas Coast, and Design of Fine-Grained Dredged Material Sedimentations Basins. A copy of the Proceedings is available for $10.00 from the Sea Grant College Program, Texas A&M University, College Station, TX 77843. ■

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Coming Events

The Eighth Ocean Energy Conference, Capital Hilton Hotel, Washington, DC, June 7–11.

Design of Water Quality Monitoring Networks, Colorado State University, Fort Collins, Colorado, June 15–18.

Waterpower '81, The Shoreham Hotel, Washington, DC, June 22–24.

Summer Short Course on Flood Prediction, Estimations and Forecasting, Colorado State University, Fort Collins, Colorado, June 29–July 3.

1981 Joint AIN/WIA National Workshop, Estes Park, Colorado, September 21–24. ■

Changes of Command

In January, **Brigadier General R.S. "Sam" Kem** became division engineer for the Ohio River Division in Cincinnati. He succeeds **Major General Harry A. Griffith**, who was promoted to the rank of lieutenant general and now heads the Defense Nuclear Agency. General Kem was previously deputy director of Civil Works in the Office of the Chief of Engineers.

Colonel Gurnie C. Gunter has been named Kansas City district engineer, Kansas City, MO, effective in May. He replaces **Colonel Walter C. Bell**. Colonel Gunter's previous assignment was deputy division engineer, Middle East Division, Riyadh, Saudi Arabia.

Colonel Charles E. Dominy succeeds **Colonel Tilford C. Creel** as district engineer of the Savannah District, effective in June. Colonel Dominy is currently chief of Construction Programs Division, Office of the Deputy Chief of Staff, Engineer, Headquarters, U.S. Army Europe and 7th Army, Heidelberg, Germany.

Also in June: **Colonel Frederick A. Perrenot** replaces **Colonel Robert D. Carpenter** as district engineer of the Far East District, Seoul, Korea, after serving as chief of the Military Engineering Division, Office of the Assistant Chief of Engineers, Washington.

Colonel James R. Whitley, Jr., currently attending the U.S. Army War College, becomes district engineer, Riyadh, Saudi Arabia; he succeeds **Colonel Edward K. Wintz.**

Lieutenant Colonel Roger L. Baldwin leaves his post as project officer of the Karlsruhe Pilot Project for Base Operations Contracts, Karlsruhe, Germany, to become Philadelphia district engineer; he replaces **Colonel James G. Ton**.

Lieutenant Colonel Julian E. Pylant, Jr., succeeds **Colonel Bernard Roth** as Albuquerque district engineer; Lieutenant Colonel Pylant is currently in the Force Planning and Programming Division, Office of the Joint Chiefs of Staff, Washington. ■

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The Hawaiian monk seals' lack of fear of man is one of the contributing factors toward their endangered status. This photo was taken on the Pearl and Hermes Reef in the Hawaiian Island Chain. See "The Hawaiian Monk Seal: An Endangered Marine Mammal" on page 1. (Photo by Karl W. Kenyon)